Comparison of BUVSs concentration in fish between this study and other study

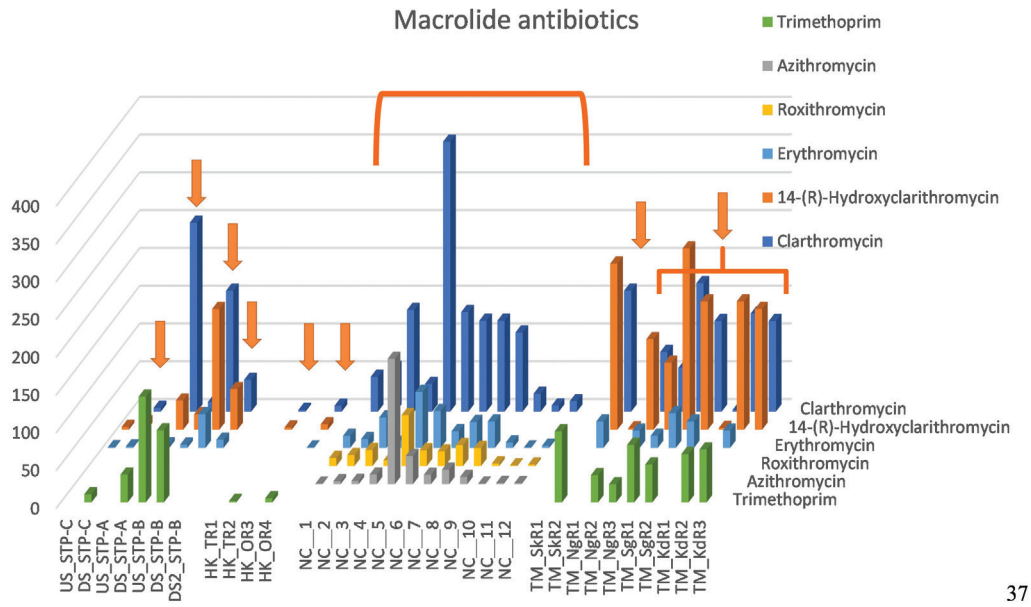
country/ area	Year	Species	Number of substances	Number of samples	Concentration (ng/g-wet) mean	Concentration (ng/g-wet) range	Reference
Tokyo , Hyogo, Hiroshima	**2021**	**Sea bass etc.**	**11**	**9**	**0.9**	**ND~4.0**	**This study**
Off Himeji and Tokyo	**2020**	**Sea bass etc.**	**9**	**20**	**1.7**	**ND～8.7**	**This study**
Off Himeji, Japan	**2019**	**Sea bass**	**8**	**5**	**14**	**1.6～43**	**This study**
Korea	2020	Crucian Carp	9	60	–	0.93～8.60	Oh et al.(20th Joint symposium on POPs reserch)
Korea	2018	Crucian Carp	7	20	0.27	0.05～0.51	Oh et al.(19th Joint symposium on POPs reserch)
China	2020	Carp etc.	6～7	174	–	around 100	Peng et al.
Spain	2020	Bogue etc.	6	144	–	1.34～45.6 (dry)	Montesdeoca-Esponda et al.
India	2018	Labeo rohita etc.	6	14	21	ND～79	Vimalkumar et al.
Canada	2018	Lake trout etc.	6	–	3.5	ND～6.7 (UV328) ND～1.0 (UV234)	Lu et al.
German	2016	Bream (liver)	9	>4		～65 (UV327)	Wick et al.
Canada	2016	Crayfish	6	35	–	<0.85～894 (UV328) <0.86～1076 (UV234)	Lu et al.
Norway	2015	Cod etc.	4	45	–	ND～51.8	Langford et al.
Asian and US	2012	Mussel	4	68		ND～33 (UV320) ND～450 (UV326) ND～150 (UV327) ND～220 (UV328)	Nakata et al.
Philippines	2011	Coral grouper etc.	8	58		6.48～316	Kim et al.
Ariake Sea, Japan	2009	Sea bass etc.	4	55	–	0.30～80	Nakata et al.

The total values of BUVSs ranged from ND to 43 ng/g wet weight.
These were within the range of the previously reported concentrations.

18

Simultaneous analysis of over 20 pharmaceutical substances in river water.

(Focused on macrolide antibiotics)



37

Risk assessment of PFRs

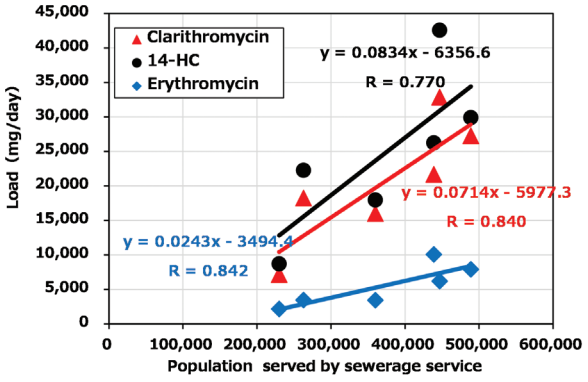
PFRs in river basins in four locations: ng/L

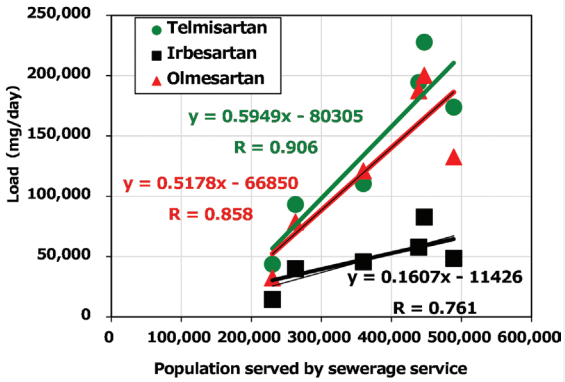
Location	River	Sampling Point	TEP	TCEP	TPP	TCPP	TDCPP	TPhP	TBP	TBOEP	TCP
Hokkaido Prefecture	Ishikari River	Nagayama Bridge	N.D.	N.D.	N.D.	11	N.D.	15	N.D.	6.4	N.D.
		Osamunai Bridge	(2.0)	N.D.	N.D.	25	3.2	N.D.	(4.7)	46	N.D.
		Ishikari-ohashi Bridge	(2.3)	(6.8)	N.D.	27	2.7	N.D.	N.D.	17	N.D.
Nagoya City	Horikawa River	Koshio Bridge	23	170	N.D.	400	47	11	140	370	3.7
	Shin-Horikawa River	Hinode Bridge	31	260	N.D.	650	68	23	47	570	4.9
	Yamazaki River	Dotoku Bridge	12	93	N.D.	260	19	7.8	11	49	N.D.
	Tenpaku River	Chidori Bridge	23	160	N.D.	620	79	17	28	200	(1.6)
Hyogo Prefecture	Kakogawa River	Mansai Bridge	N.D.	N.D.	N.D.	24	3.0	N.D.	27	10	N.D.
		Kamisou Bridge	4.4	25	N.D.	91	13	N.D.	28	21	N.D.
		Kakogawa Bridge	(3.4)	20	N.D.	66	9.6	N.D.	25	10	N.D.
Tokyo Prefecture	Tama River	Nagata Bridge	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
	Akikawa River	Higashiakikawa Bridge	N.D.	N.D.	N.D.	(5.4)	N.D.	N.D.	N.D.	N.D.	N.D.
	Hirai River	Tasai Bridge	N.D.	N.D.	N.D.	10	N.D.	N.D.	N.D.	N.D.	N.D.
	Zanbori River	Tappi Bridge	(1.6)	(7.6)	N.D.	(4.5)	N.D.	N.D.	N.D.	N.D.	N.D.
	Tama River	Hino Bridge	(2.5)	22	N.D.	73	11	(2.0)	N.D.	25	N.D.
	Yachi River	Shinasahi Bridge	3.8	(11)	N.D.	23	(1.8)	3.9	N.D.	3.0	N.D.
	Tama River	Sekito Bridge	(3.1)	27	N.D.	100	15	(1.5)	(3.2)	37	N.D.
	Asakawa River	Takahata Bridge	N.D.	(11)	N.D.	12	(1.1)	N.D.	N.D.	4.3	N.D.
	Oguri River	Houon Bridge	(3.0)	(11)	N.D.	42	(1.6)	(3.0)	N.D.	12	N.D.
	Tama River	Tamagawara Bridge	5.3	36	N.D.	120	15	4.3	(3.6)	38	N.D.
PNEC			632,000	100,000	—	420,000-640,000	200	3,000	21,000	24,000	150

Water samples were collected from 4 institutes, and analyzed by Tokyo-group.

Correlation between Pharmaceutical loads from STPs and population

STPs in Tokyo area





Correlation coefficients（R）：0.761~0.906

High correlation between Pharmaceutical loads and population

High loads from populous urban areas

Chapter 4

Visible Contribution to Policies

4.1. Establishment of POPs Measurement Analysis Method
4.2. East Asia POPs Monitoring
4.3. POPs Measurement Analysis Training Program for East Asian POPs Officials
4.4. Scientific Publication
4.5. Contribution Effect to Private POPs Collaborative Research

4-1. Establishment of POPs Measurement Analysis Method

[In Korea] The POPs official test methods were established based on the existing dioxin official test methods, the research results on OCPs among the harmonization projects for Korea-Japan POPs measurement and analysis methods, and the 3-year research results of a private professional organization (January 27, 2007) . As a party to the Stockholm Convention (joined on January 25, 2007), Republic of Korea submitted a National Implementation Plan to UNEP in 2009 to establish a POPs monitoring system to implement the convention and evaluate its effectiveness.

In relation to this, the Persistent Organic Pollutants Management Act was enacted by Act No. 8292 (January 26, 2007) (enforced on January 27, 2008), mandating the use of the POPs process test method in Article 19 (1), and supplementary provisions (No. 8292, January 26, 2007). As of Article 4, the POPs official test methods were established and operated in accordance with Article 6(1) 10 of the Act on Environmental Testing and Inspection.

POPs regulated in the Stockholm Convention include dioxin, furan, polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB), aldrin, dieldrin, and endrin. There are 12 items including Endrin, DDTs, Heptachlor, Mirex, Chlordane, and Toxaphene. There are a total of 11 target media, including environmental media in 7 fields including atmospheric environment, exhaust gas, river/lake water, wastewater, soil/sediment, liquid waste, and solid waste, and biological media in 4 fields including blood, breast milk, shellfish, and fish.

The system includes 42 official test methods for 4 items of unintentionally produced persistent organic pollutants (UPOPs) such as dioxin, 51 methods for 8 items of organo-chlorine pesticides (OCPs) such as aldrin, and 88 methods for 12 items of POPs for biological samples such as blood.

The preparation system of official test method consists of 25 methods in total, including 18 methods from ES10900.1 to ES 10917.1 as the first method (HRGC/HRMS) and 7 methods as the second method (HRGC/LRMS). The component process test methods range from ES10300 to ES10899, with 30 units for each matrix, and are divided into 156 methods, 96 methods for the first method and 60 methods for the second method. The unique number for each official test method was assigned in accordance with the 「Environmental Pollution Official Test Method Standardization Guidelines」, where ES is Environmental Standard, 10 means persistent organic pollutants, 300-899 are individual analysis methods, and 900-999 are multi-component simultaneous analysis methods.

In the first decimal place, 1 means the first method and 2 means the second method. The table of contents for each method is in accordance with the “Guidelines”: 1. Overview (purpose, scope of application, interfering substances), 2. Definition of terms, 3. Test

equipment and apparatus, 4. Reagents and standard solutions, 5. All methods were written in the same framework in the following order: sample collection and management, 6. QA/QC, 7. Test procedures, 8. Result reporting, 9. References, and 10. Appendix.

The main analyzer is a high-resolution gas chromatograph/high-resolution mass spectrometer(HRGC/HRMS) as the first method, and to complement this, a high-resolution gas chromatograph/mass spectrometer (HRGC/LRMS) is used as the second method.

However, in the process of adding official test method for new POPs substances, single-component analysis methods that overlap with the multi-component simultaneous analysis method were deleted, so 57 methods are specified, a decrease from 181 methods at the time of enactment.

Korea's POPs official test methods were harmonized with Japan during collaborative research. With this method, Korea and Japan are playing a leading role in the East Asian POPs monitoring project. It is also used as a main subject in the East Asian POPs manager training program hosted by Korea.

[In Japan] Japan has a long history of analyzing POPs in the environment. After the experiences of severe chemical pollution in 1960's, Environment Agency was established in 1971, and Act on the Regulation of Manufacture and Evaluation of Chemical Substances in 1973. Under the law, top priority for regulation was put on such chemicals with highly persistent, bioaccumulative and toxic (PBT) properties. The chemicals with PBT properties, which are basically same as POPs, were designated as Class 1 specified chemical substances and their manufacture, import and use were prohibited or strictly regulated in Japan.

Environment Agency also started national environmental monitoring in 1974, and the long term monitoring of Class 1 designated chemical substances from 1978. Wildlife samples, such as fishes, bivalves and birds were collected to reveal the pollution status of POPs by GC/ECD. With the development of analytical method by GC/quadrupole MS (GC/qMS), analysis of sediment and water samples started in 1986, while GC/ECD was continuously used for the analysis of POPs in biological samples.

In 1990's, dioxin pollution became a big issue in Japan. Official method was developed to analyze quite low levels of dioxins sensitively and accurately in various environmental matrices, such as air, water, sediments and biota, by using capillary GC/high resolution MS (HRGC/HRMS) and isotope labeled surrogates.

POPs monitoring was re-organized and expanded to cover air in addition to water, sediment and biota in 2002 in accordance with the request of Stockholm Convention. The Convention asked Parties to provide POPs trend data at background sites in each region/sub-region. On the other hand, n.d. data had been increased recently due to inferior sensitivity of GC/ECD or GC/qMS.

In order to fulfill the mandate to reveal current POPs levels and their decrease in background sites, sampling and analytical method of dioxins using HRGC/HRMS were modified to establish highly sensitive POPs monitoring method, except for toxaphene which were analyzed by GC/NCI-MS (GC/ECNI-MS). In Japanese method, high volume air sampler was modified to add active carbon fibre felt (ACF) as a backup to trap even fairly volatile POPs, such as HCB and α-HCH, efficiently. The HV sampler, in fact, was found to be applicable for not only legacy 12 POPs but also many of new POPs.

By the addition of new POPs in the list, a new analytical method based on LC/MS/MS rather than GC/MS was also developed for the analysis. Clean-up process is more and more complicated to analyze many POPs chemicals in the same samples. There are several alternative clean-up processes to remove interferences efficiently and analyze POPs accurately. Instead of fixing clean-up procedure, efforts were made to set up robust QA/QC procedure to obtain high quality data in the POPs monitoring in Japan. An expert committee was set-upped and checked the quality of the data every year.

As a member of Global Coordination Group under the Stockholm Convention, Japan contributed to make guidance for Global Monitoring Plan (GMP) of the Convention by developing new POPs analytical methods and providing the information to improve the guidance. Such information and experiences are also shared with researchers in Korea in the bilateral collaboration on the harmonization of POPs analysis in recent years, and make basis to support POPs monitoring in East Asian countries (POPsEA) supported by Japan and POPs analysis training program supported by Korea.

4-2. East Asia POPs Monitoring

The Stockholm Convention stipulates that, in addition to regulating the production of POPs, the Parties conduct domestic and international environmental monitoring to verify the presence of POPs in humans and the environment (Article 11), and to assess the countermeasure effectiveness of the Stockholm Convention, by using the monitoring data and other information (Article 16).

In order to support the Parties in the East Asia region to implement the obligations and to contribute to the effectiveness evaluation of the Stockholm Convention, Japan launched the Environmental Persistent Organic Pollutants Monitoring Project in East Asian Countries (POPsEA Project) in 2001, and has been holding workshops on the POPsEA Project, gathering government officials and/or experts from East Asian countries.

At the first workshop in December 2002, the participants, recognizing insufficient information on the levels of POPs in the environment in the East Asia region, agreed that further regional cooperative efforts should be made to fill in the data gaps, taking into account all the various conditions relevant to the East Asian countries. At the second workshop in December 2003, the participant discuss technical aspects for environmental POPs monitoring in the region and future works under the POPsEA Project, and then Japan offered to support regional activities on environmental monitoring by: providing technical support of sampling (e.g. air sampling); supporting analysis of samples collected in the region, by providing on-site training of POPs analysis; and contributing to data validation, QA/QC and data treatment for the data gained through above activities. After the trial phases in 2004, Japan has supported environmental monitoring of the East Asia countries under the POPsEA Project since 2005.

The current objectives of the POPsEA Project are:
- to know the background levels of POPs in the environment at the East Asia Sub-region;
- to provide comparable and scientifically sound data on the media considered as essential; and
- to contribute to the effectiveness evaluation under the Stockholm Convention, Article 16.

Ten East Asian countries (Cambodia, Indonesia, Japan, (Republic of Korea, Lao PDR, Malaysia, Mongolia, the Philippines, Thailand, and Vietnam) has participated in the monitoring activity under this Project. The major classification of the POPs monitoring implementation under this project is as follows;

1) **Super-site Monitoring**: Considering the Guidance of Global Monitoring Plan, some background sites in East Asian Countries are selected as “super-sites” for long-term frequent air monitoring of POPs. Each country which nominated the super-site implements sampling and analyses with its own laboratory and budget. Cape Hedo (Japan) and Jeju Island (Korea) have been agreed as super-sites for monthly sampling. Furthermore, it was agreed at the past workshops that the sites nominated by

Thailand and the Philippines were the candidate super-sites for quarterly monitoring, and Japan has supported capacity building of these countries.

2) **Cooperative Monitoring**: Considering the current frequency of the effectiveness evaluation of the Stockholm Convention, member countries of this project have conducted monitoring at least once every six years. Japan has contributed to their activities, considering their capabilities, by dispatching Japanese engineer for sampling, analyzing their samples at Japanese laboratory etc.

The current objectives of the Workshops on the POPsEA Project are:
- to review the POPs monitoring results obtained in this project;
- to exchange the views on policy and technical aspects of the POPs monitoring; and
- to discuss the update of the existing monitoring plans and future directions of the activities in this project.

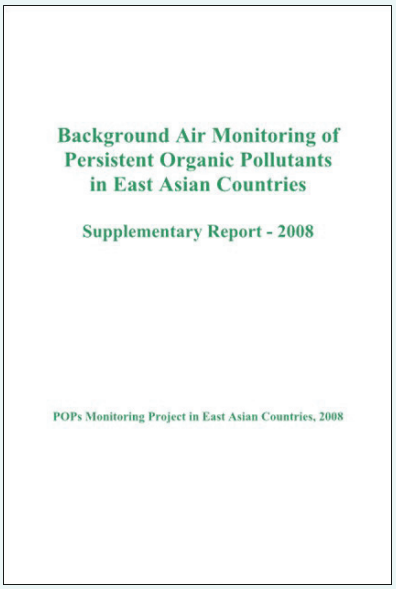
The reviewed data has been summarized to Sub-regional Reports of POPsEA project, called "Background Air Monitoring of Persistent Organic Pollutants in East Asian Countries", which have been submitted to Regional Organization Groups under the Stockholm Convention, and incorporated to the Regional Monitoring Reports for Asia and the Pacific, and consequently the Global Monitoring Reports and the Reports on the Effectiveness Evaluation.

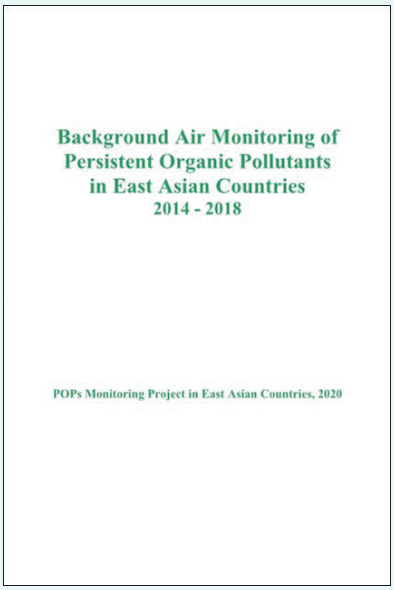
As described, by organizing an international cooperative monitoring system in the East Asia region and continuously collecting monitoring data, the POPsEA Project has supported East Asian countries to implement the obligations and contributed to the effectiveness evaluation of the Stockholm Convention.

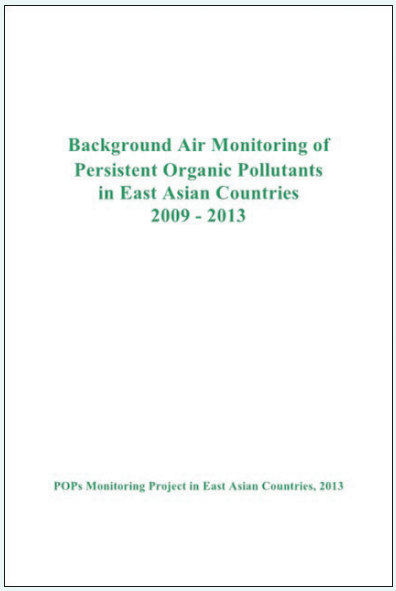
Member countries of the POPsEA Project

- Kingdom of Cambodia
- Republic of Indonesia
- Republic of Korea
- Japan
- Lao People's Democratic Republic
- Malaysia
- Mongolia
- Republic of the Philippines
- Republic of Singapore
- Kingdom of Thailand
- Socialist Republic of Viet Nam

Sub-regional Reports of POPsEA project







4-3. POPs measurement analysis training program for East Asian POPs Officials

As part of the support project for developing countries under the Stockholm Convention, Korea has been conducting an annual POPs analysis technology education program since 2011. The aim is to foster collaboration among East Asian countries and enhance their capabilities in POPs analysis.

NIER has been actively promoting educational projects in analysis technology to reinforce POPs monitoring capabilities in East Asian countries. The goal has been to lead collaborative efforts among countries in East Asia to decrease POPs and assist in evaluating the implementation performance of the Stockholm Convention.

Over the past 12 years, approximately 170 individuals have been invited to participate in the POPs education program. The POPs measurement and analysis education program was divided into six parts for 8 to 11 East Asian countries involved in POP monitoring as follows.

1) **Sampling and pretreatment methods**: 「Comparison of Korea, US-EPA, and Japanese proposal methods for POPs pretreatment and analysis in the environmental atmosphere」, 「Education on dioxin field sampling in flue gas, sample extraction, clean-up process, and instrumental analysis」, 「Introduction of POPs analysis trends in GMP and comparison on principle of manual and automatic sampler」,

2) **Instrument analysis method**: 「Education on the fundamental analytical technology theory and practical courses for POPs monitoring, including education on the principles and applications of HRGC/HRMS, LC-MS/MS analysis equipment」, 「History of mass analysis, ionization methods, mass detection, accuracy, resolution, and analysis methods for POPs such as dioxins, PBDEs, PFCs, PCBs using mass analysis」, 「New POPs analysis methods and research trends for compounds such as chloronaphthalene, short-chain chlorinated paraffins, and perfluorinated compounds」, 「Introduction to mercury monitoring methods by chemical species in the atmosphere」, 「Analysis methods for atmospheric mercury (automatic and passive sampling) and mercury in rainfall」

3) **Measurement & Analysis theory**: 「Theory on emerging POPs such as perfluorinated compounds, brominated flame retardants, organochlorine pesticides, polybrominated diphenyl ethers (PBDEs)」, 「Theoretical background and sample collection for dioxin contamination」, 「Introduction to the behavior characteristics and analytical techniques of microplastics as carriers of POPs」

4) **QA/QC**: 「Development of Proficiency Test Sample Technology for DDT Analysis Quality Control」, 「Laboratory Safety and Quality Control in Fine Chemicals Analysis」

5) **Research Trends**: 「Introduction to WHO's Strategies for POPs Management (Activities Linked to WHO Collaboration Centers)」, 「Overview of Health Impacts of POPs and Endocrine Disrupting Chemicals (EDCs)」, 「Discussion on the Health Impacts of POPs on Vulnerable Groups, such as Children」, 「Introduction to Monitoring Technology for Hexachlorobutadiene and Perfluorinated Compounds in the Atmosphere」, 「Methodology and Results of POPs Concentration Investigation in Environmental Atmosphere」, 「Current Status of POPs Analysis in Korea's Multi-Media Environment」, 「Behavior of POPs in a Multi-Media Environment and Monitoring Results of New POPs such as Brominated Flame Retardants」

6) **Field Training and Experience**: 「Efficient Field Education Utilizing Fine Organic Contaminant Pretreatment Laboratory and High-Resolution Mass Spectrometer in Korea」, 「Practical Training on Dioxin Sample Collection from Atmospheric Flue Gas」, 「Exploration into Cultural Heritage in Seoul and Incheon Regions, including Korean Traditional Costume (Hanbok) and Cuisine (Hansik)」 etc.

In this way, the training program for POPs officers in the East Asia region strengthens the capacity of the relevant country to respond to international POPs issues and contributes to building future technological cooperation in the East Asia region.

POPs education & training program photos

2014

<Practice of sample pre-treatment>

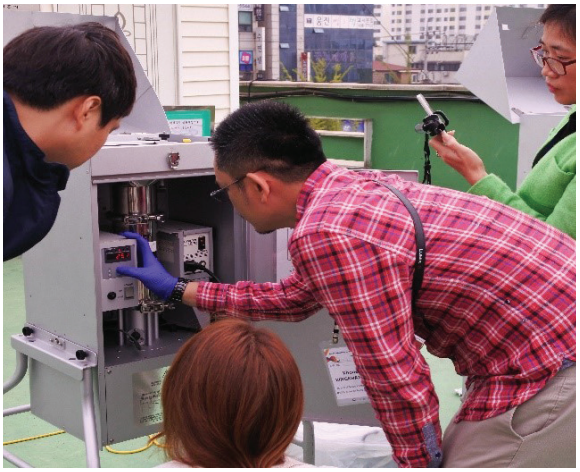
<Participants of analysis education>

2015

<Analytical method training>

<Participants of analysis education>

2016



<Practice of on-site air sampling>

<Sample pre-treatment>

2019

<Analytical method training>

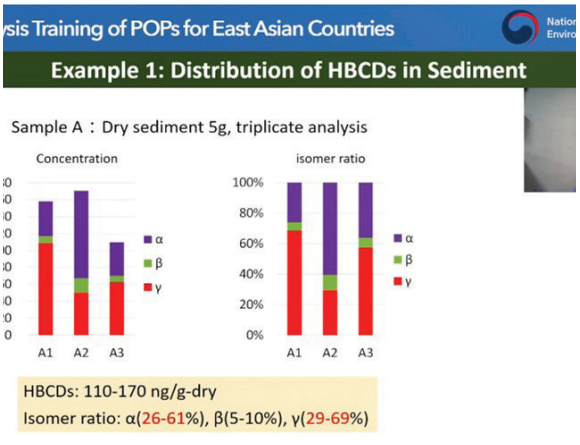
<Lab. Tour>

2021

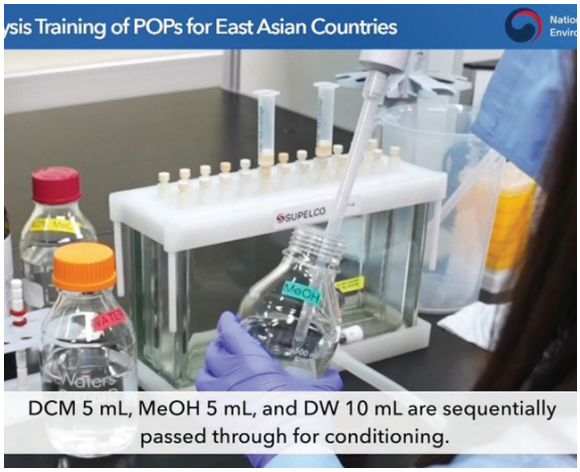
<Sampling training (on-line meeting)>

<Participants for on-line training>

2022



<Lecture through zoom meeting>



<analytical experiments (on-line)>

4-4. Scientific Publication

Chau, H.T.C., Kadokami, K., Ifuku, T., Yoshida, Y., 2017. Development of a comprehensive screening method for more than 300 organic chemicals in water samples using a combination of solid-phase extraction and liquid chromatography-time-of-flight-mass spectrometry. Environmental Science and Pollution Research 24, 26396–26409.

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Cho, C., Lee, D.-H., Lee, B., Kim, S., Choi, K., Yoon, J., 2010. Residual Concentrations of perfluorinated compounds in water samples of Anseong and Gyeongan streams and their spectroscopic characteristics. Journal of the Korean Society for Environmental Analysis 13, 226–236.

Cho, H.-S., Horiguchi, T., 2017. Current status of contamination by organotins and imposex in prosobranch gastropods in Korea, In Biological Effects by Organotins. ed. T. Horiguchi, pp. 149–163. Springer Japan, Tokyo.

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Choo, G., Cho, H.-S., Park, K., Lee, J.-W., Kim, P., Oh, J.-E., 2018. Tissue-specific distribution and bioaccumulation potential of organophosphate flame retardants in crucian carp. Environmental Pollution 239, 161–168.

Choo, G., Wang, W., Cho, H.-S., Kim, K., Park, K., Oh, J.-E., 2020. Legacy and emerging persistent organic pollutants in the freshwater system: Relative distribution, contamination trends, and bioaccumulation. Environment International 135, 105377.

Horiguchi, T., Lee, J.-H., Park, J.-C., Cho, H.-S., Shiraishi, H., Morita, M., 2012. Specific accumulation of organotin compounds in tissues of the rock shell, *Thais clavigera*. Marine Environmental Research 76, 56-62.

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Iwabuchi, K., Tatarazako, N., 2018. Relationship between occurrences of perfluoroalkyl acids in medaka, environmental water, and sediment in its habitat and bioconcentration. Journal of Japan Society on Water Environment 41, 61–71.

Iwamura, T., Jinya, D., Kadokami, K., Kajiwara, Y., Kusuda, T., 2012. Nationwide study of hexabromocyclododecanes in crucian carp (*Carassius auratus* (*gibelio*) *langsdorfii*) in Japan: Accumulation levels, spatial distributions and maternal transfer. Journal of Environmental Chemistry 22, 25–32.

Iwamura, T., Kajiwara, Y., Jinya, D., Kadokami, K., Kusuda, T., 2011. Accumulation levels and spatial

distributions of organochlorine pesticides in crucian carp (*Carassius auratus* (*gibelio*) *langsdorfii*) in Japan. Journal of Environmental Chemistry 21, 57–68.

Jeong, G., Kadokami, K., Iwamura, T., Kajiwara, Y., Choi, K., Joo, C., 2010. Comparison of persistent organic pollutants levels in freshwater fish (crucian carp) between Korea and Japan. Organohalogen Compounds 72, 267–270.

Jeong, G.H., Hwang, N.R., Hwang, E.-h., Lee, B.-c., Yoon, J., 2014. Hexabromocyclododecanes in crucian carp and sediment from the major rivers in Korea. Science of The Total Environment 470-471, 1471–1478.

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4-5. Contribution Effect to Private POPs Collaborative Research

Based on the collaborative efforts between South Korea and Japan concerning Persistent Organic Pollutants (POPs), there has been a significant increase in friendship among researchers from both countries.

In June 2009, to promote the advancement of research and facilitate expert exchanges between the academic societies of both countries, the President of the Korean Environmental Analysis Society, Kim Sam-Cwan, proposed and subsequently signed an MOU with the President of the Japanese Environmental Chemistry Association, Morita Masatoshi.

(MOU signed by the presidents of the Korea-Japan Society) - Chairman Masatoshi MORITA on the left, Chairman Samcwan Kim on the right.

In 2009, a collaborative MOU took place at the Tsukuba International Conference Hall in Japan, engaging 83 Korean environmental researchers and 835 Japanese counterparts. The event was jointly organized by the Japan Environmental Chemical Society and the Korea Environmental Analysis Society.

In 2009, a collaborative MOU took place at the Tsukuba International Conference Hall in Japan, engaging 83 Korean environmental researchers and 835 Japanese counterparts. The event was jointly organized by the Japan Environmental Chemical Society and the Korea Environmental Analysis Society.

A total of 471 presentations were delivered during the conference, including 28 oral presentations at the Korea-Japan joint conference, 23 oral presentations for international sessions, and 291 poster presentations.

During the conference, Kim Sam-Cwan, the chairman of the Korean Society of Environmental Analysis, delivered a special lecture on “The Current Status and Prospects of POPs Management in Korea,” while Morita Masatoshi, the chairman of the Japanese Society of Environmental Chemistry, presented a special lecture on “The Prospects of Environmental Chemical Substances”.

Furthermore, it was proposed that both Korean and Japanese academic societies both the Korean and Japanese academic societies proposed collaborating on studies regarding the measurement and analysis methods, actual surveys, pathway of long-range transport, and hazard assessments of new POPs in the future.

(Main attendees of the 2009 Korea-Japan joint academic conference)

At the joint academic conference in 2010, there was a consensus that, despite the geographical proximity of the two countries, there were limitations in the advancement of academic collaboration due to the lack of opportunities for open discussions between Korean and Japanese researchers.

To overcome this challenge, there was a shared consensus on the need to rejuvenate collaborative research efforts between the two countries. The goal was to establish a platform for substantive academic discussions on recent research trends between Korea and Japan regarding environmental chemicals such as POPs, EDCs, PPCPs, asbestos, and mercury, as well as climate change, through interactive meetings that transcend academic journals.

From November 3 to 5, 2010, the 2nd Korea-Japan Joint Seminar on Environmental Chemicals, themed “Leading Environmental Research in East Asia,” was held at the 100th Anniversary Memorial Hall of Sookmyung Women’s University in Seoul, in conjunction with the 2010 Korea Environmental Analysis Society Fall Conference.

Over 420 participants, including 100 members from the Japanese Environmental Chemical Society, attended the seminar. The academic conference included three special lectures (one each from Korea, Japan, and the United States), 24 joint sessions between Korea and Japan (12 in Korea, 12 in Japan), 32 oral presentations and 154 poster presentations in the Korean sessions, and 10 oral presentations and 65 poster presentations in the Japanese sessions.

During the Korea-Japan conference, a notable event occurred in 2009 in Japan, where researchers and industry experts introduced themselves and exchanged opinions while enjoying boxed meals in the evening.

Moreover, the Korean Society of Environmental Analysis presented the Japanese Environmental Chemistry Society with a poem by the Great Monk of Seosan, inscribed on a hanging scroll. The poem read, “What’s strange in the mountains, many pine nuts on rocks, flat or rough, and all in the same color, always conveying the same color.”

(Main attendees of the 2010 Korea-Japan joint academic conference)

The intention behind this gesture was to promote ongoing exchanges through a joint symposium initiated by the two leaders of environmental research in East Asia. It is unfortunate that the initiative has been suspended.

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Chapter 5

Development Prospects of Korea-Japan CJR

5. Development Prospects of Korea-Japan CJR

The Korea-Japan CJR is thought that the research for the country and the people should precede technology development. Finding research for the public interest would be a desirable attitude for researchers working at national research institutes. Since a good policy research is directly linked to improving the life quality of people, research is needed to find and solve nearby problems first rather than distant problems. In other words, tasks should be preceded such as for the development or improvement of policies and systems, the enactment and amendment of emission regulations in environmental media, the mediation of domestic and foreign environmental disputes, or the response to international conventions.

Since the Korea-Japan CJR has been centered on EDCs and POPs for the past 20 years, it seems that the order is to first look at their general characteristics and discuss their development direction.

In case of EDCs, a method of evaluating the presence or the absence of chemical's effects to endocrine system and the level of its impacts on the basis of 'medical and pharmaceutical toxicity' sometimes has difficulties and disputes in scientific argumentation or proof of evidence.

In particular, due to the uncertainty that appears when applying animal test results performed on mice to human toxicity, there is always a debate among researchers over the scientific validity of toxicity assessment. In some cases, it requires the trans-generational observation time and a lot of research costs to prove it. Therefore, the academic purpose of evaluating and studying endocrine disorders is very necessary, but considering the practical aspect of national research that should provide the visible results to the public within a certain period of time, it cannot but be said that the research priority is behind.

On the other hand, since the research on POPs usually uses the physico-chemical characteristics as an evaluation tool such as persistency, long-range transport potential, bio-accumulation or magnification, etc., there are some advantages of having relatively few scientific debates, short time for proofing the scientific evidence, and low research cost. Consequently, many countries have been shifting their management policies and regulations from EDCs to POPs.

As such, many countries around the world are implementing their policies and research directions focusing on POPs in order to comply with international agreements in the environmental sector such as the Stockholm Convention.

In this context, it would be better to be in line with the international flow and to conduct the Korea-Japan CJR focusing onto the unregulated POPs by the national research institutes including other institutes, academia, etc.

Some suggestions for the future direction of CJR are as follows.

First, focusing on continuous in-depth tasks by securing a dedicated budget for joint research: Away from the monotonous projects such as establishing the test methods for the existing or new POPs, or investigating the accumulation or pollution status, which have been carried out as non-budget short-term tasks. It is needed to develop the new-concept methodologies that can adjust environmental disputes by scientifically defining the exposure level or the change by elapsed time through metabolite analysis, etc.

Second, conducting necessary policy development and improvement research tasks: In accordance with the purpose of establishing a national research institute, it would be better to research the development of policies or regulations to respond to new pollution phenomena or pollutants and the improvement of the current system as a joint research.

Third, challenging the research for the settlement of international dispute and the convention response: Rather than limiting the research area inside the country, the researches on trans-boundary pollutants, such as ultra-fine dust, mercury and arsenic, microplastics or environmental radioactive substances, which have recently become a international problem, are thought of necessary as CJR projects.

Based on the mutual benefit and prosperity, the CJR which can produce the practical and pragmatic results is thought to be desirable. The dedicated research funds must be necessarily secured for a more in-depth CJR. It should be noted that the environmental authorities of both countries should no longer neglect their efforts to secure the dedicated budgets.

So far	To be
1. Non budget: oriented to short-term tasks - Establishment or Harmonization of existing-item test methods - Survey on ecological and environmental contamination status	**1. Dedicated budget: focusing on in-depth tasks** - Research & Development of a new concept test methods - Identification of emerging pollutants or phenomena
2. Absence of policy & regulatory tasks	**2. Challenge for policy & regulatory tasks**
3. Domestic Korea and Japan: - POPs & Hg in each country	**3. Regional and Global** - Trans-boundary substances, or environmental radioactives

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Chapter 6

Closing Remarks

6. Closing Remarks

Over the past 20 years, about 70 more Cooperative Joint Research (CJR) tasks have been published. The CJR was initially conducted on Endocrine Disrupting Chemicals (EDCs), but its scope later shifted to Persistent Organic Pollutants (POPs) with a focus on monitoring and analyzing chemicals.

While these joint research efforts have brought some academic and institutional advancements, there have also been areas for improvement. Nevertheless, the Government Official Meeting (GOM) and the CJR initiatives are regarded as valuable opportunities that have facilitated closer collaboration and mutual understanding between policy makers and researchers in both countries.

However, Korea and Japan, both countries have not secured the dedicated budgets for the CJR. Thus, the tasks have been carried out with their own respective for-other-task budgets, performing short-term tasks such as establishing or harmonizing test methods for pollutants, or investigating pollution conditions on ecological or environmental media.

Therefore, it is proper time to change them into the in-depth researches, such as the discovery and implementation of pragmatic and practical CJR tasks, and the development of a new concept of test methodology that can scientifically define and adjust the domestic and foreign environmental disputes. To this end, both countries must secure the exclusive research funds to establish the more solid collaboration for the better future environment.

The National Institute of Environmental Research (NIER) in Korea and the National Institute for Environmental Studies (NIES) in Japan, the main pillars of the CJR believe that two institutions should be jointly studied for the development and improvement on environmental policies, regulations or systems due to the nature of national research institutes. Trans-boundary pollutants such as ultra-fine dust, mercury and arsenic, microplastics, or environmental radioactive substances are also needed to be studied as CJRs as well in order to mediate the disputes in Northeast Asia.

Currently, extrapolating the results of ecological or animal tests as an effect on human health has the uncertainty and limitation of toxicity research on hazardous chemicals today. Nevertheless, a variety of scientific methodologies should be researched and developed continuously for better understanding the potential risks of harmful substances to our health and for proving the distinct evidences of those clearly.

In addition, for a more accurate and reliable evaluation on human health effects related to the exposure to EDCs or POPs, the interdisciplinary cooperation for joint research is necessary along with the scientific progress in relevant fields. Also, the CJR between two countries should be further activated due to the regional pollution caused by trans-

boundary or long-range transport pollutants.

In this context, the Korea-Japan CJRs, which have been conducted over the past 20 years, would be the basis for the academic love-plus partnership of the future from the political love-hatred relationship of the past two countries.

Finally, the authors here deliver the thanks to all Korea-Japan policymakers and researchers who have participated in the GOM and the CJR, hoping that the CJR will continue to serve as a practical channel for dialogue on the basis of mutual benefits.

In memory of Dr. Masatoshi MORITA

Dr. Masatoshi MORITA passed away on 22 December 2023 at the age of 79.

He was the head of the Japanese researchers at the initial stage of this collaborative study and laid the foundation for the stable development of the collaboration between the two countries through his outstanding leadership and close relationship with the Korean researchers.

Dr. MORITA showed a distinguished ability not only to conduct research but also to solve pollution problems by collaborating with experts / stakeholders in many different fields / countries, as represented in his leading role in this bilateral program. His research interests covered so many different scientific fields, including speciation analysis of As and Hg, stable and radioactive isotope analysis including ^{14}C by AMS, instrumental and biological analysis of pollutants including dioxins and EDCs, chemical decomposition of PCBs, and remediation of radioactive contamination. He founded and led dioxins and EDCs researches at NIES, and was a founding member of related Japanese scientific societies. He also committed many governmental activities as expert of pollution issues. We recognize his great contribution to this fruitful bilateral program and hope to further develop this activity to realize his dream, 'pollution-free' society.

Dr. Yasuyuki SHIBATA
Emeritus Researcher, National Institute for Environmental Studies
ex-Chairman of Japan Society for Environmental Chemistry

We mourn the passing of Dr. MORITA, who left us in 2023. I first met him in October 1991 at the National Institute for Environmental Studies in Japan. With a gentle smile, he guided me through the lab tour, explaining the work being done. He then gave me a copy of the first edition (June 1991) of Journal of Environmental Chemistry, which he had founded.

Our relationship began there and continued through various collaborations, starting with a joint research project on Endocrine Disrupting Chemicals (EDCs) between Korea and Japan in 2000. Notably, in 2009, when I was the chairman of the Korea Society for Environmental Analysis and Dr. MORITA was the chairman of the Japan Society of Environmental Chemistry, we co-hosted an international symposium in Tsukuba, Japan, fostering academic exchanges between scientists from both countries. Dr. Masatoshi MORITA was always dedicated to advancing the research cooperation between our two nations, working quietly with a gentle smile. It is with great sorrow that I write this message, mourning his passing at the age of 79, and offering my deepest condolences.

Dr. Samcwan KIM
ex-President of National Institute of Environmental Research.
ex-Chairman of Korea Society of Environmental Analysis

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APPENDIX

A-1. The 1st ~ 22nd Korea-Japan Co-operative Joint Research Symposium

The 1st Korea-Japan Co-operative Joint Symposium (Seoul, 7 December 2001)

- EDCs management in Japan.
  : Dr. Manabu Sumi (Ministry of Environment, Japan)
- Environmental contamination of POPs in Asia
  : Prof. Shinsuke Tanabe (University of Ehime, Japan)
- Development of bioassay using Medaka fish
  : Mr. Norihisa Tatarazako (NIES, Japan)
- Imposex and masculinization of female gastropods cocerning oganotin contamination
  : Dr. Toshihiro Horiguchi (NIES, Japan)
- EDCs management in Korea.
  : Mr. Suk-Jo LEE (MOE, Korea)
- Environmental monitoring of EDCs
  : Dr. Kyung-Hee CHOI (NIER, Korea)
- Screening method for EDCs using mokecular biomaker
  : Mr. Chul-Woo LEE (NIER, Korea)
- In vitro approach to evaluate ecotoxicological effects of EDCs
  : Prof. Kyu-Hyuck CHUNG (SungKyunKwan University, Korea)

The 2nd Japan-Korea Co-operative Joint Symposium (Tskuba, 6 December 2002)

- EDCs Research Strategy/Current Status & Plan/Achievement.
  : Kyung-Hee CHOI (NIER, Korea)
- A Strategy for an Eco-epidemiological Approaches to the Detection of EDCs and Current Activities in Korea.
  : Prof. Kyu-Hyuck CHUNG (SungKyunKwan University, Korea)
- Comparison of the amount of dioxin accumulation in fish and shellfish
  : Prof. Gi-Ho JEONG (Pusan National University, Korea)
- Evaluation of a multimedia mass balance model - PAHs in Mid Part of Korea-
  : Prof. Dong-Soo LEE (Seoul National University, Korea)
- Endocrine Disruption Studies using Medaka in NIER Korea.
  : Dr. Moon-Soon LEE (NIER, Korea)
- Comparison Of The Amount of Dioxin Accumulation In Fish and Shellfishes
  : Dr. Kiwao Kadokami (Kitakyushu City Inst. of Environ. Sciences, Japan)
- POPs Monitoring Activities in Japan.
  : Noriya Nakajima (MOE, Japan)
- Comparison study on dioxin inventory estimation.
  : Prof. Gon Ok (Pukyong National University, Korea)
  : Dr. Noriyuki Suzuki (NIES, Japan)

The 3rd Korea-Japan Co-operative Joint Symposium (Jeju, 16 January 2004)

1. Development of the examination method using medaka.
   : Dr. Moon-Soon Lee (NIER)
   : Dr. Norihisa Tatarazako (NIES)
2. Comparison of the level of dioxin accumulation in in-land fish.
   : Prof. Gi-Ho Jeong (Pusan National University)
   Dr. Kiwao Kadokami (Kitakyushu City Inst. of Environ. Sciences)
3. Standardization of wildlife monitoring methods.
   : Prof. Kyu-Hyuck Chung (SungKyunKwan University)
   : Prof. Shinsuke Tanabe (University of Ehime)
4. Research on fate modeling of endocrine disrupters.
   : Prof. Dong-Soo Lee (Seoul National University)
   : Dr. Hiroaki Shiraishi (NIES)
5. Comparison study on dioxin inventory estimation.
   : Prof. Gon Ok (Pukyong National University)
   : Dr. Noriyuki Suzuki (NIES)

The 4th Japan-Korea Co-operative Joint Symposium (Fukuoka, 28 January 2005)

1. Development of the examination method using medaka.
   Japan: Dr. Norihisa Tatarazako (NIES)
   Korea: Dr. Kyung-Hee Choi (NIER)
2. Comparison of dioxin levels in in-land fish.
   Japan: Dr. Kiwao Kadokami (Kitakyushu City Inst. of Environ. Sciences)
   Korea: Prof. Gi- Ho Jeong (Pusan National University)
3. Standardization of wildlife monitoring methods.
   Japan: Prof. Hisato Iwata (Ehime University)
   Korea: Prof. Kyu-Hyuck Chung (Sungkyunkwan University)
4. Research on fate modeling of endocrine disrupters in aquatic system.
   Japan: Dr. Hiroaki Shiraishi (NIES)
   Korea: Prof. Dong Soo Lee (Seoul National University)
5. Comparative study of dioxin and dioxin like compounds inventory of Korea and Japan.
   Japan: Dr. Noriyuki Suzuki (NIES)
   Korea: Prof. Gon Ok (Pukyong National University)
6. Harmonization of analytical methods for dioxin and other POPs between Korea and Japan.
   Japan: Dr. Yasuyuki Shibata (NIES)
   Korea: Dr. Sam-Cwan Kim (NIER)

The 5th Korea-Japan Co-operative Joint Symposium (Busan, 19 January 2006)

1. Development of the examination method using medaka.
   : Hyun-Mi KIm (NIER)
   : Norihisa Tatarazako (NIES)
2. Comparison of the level of dioxin accumulation in in-land fish.
   : Gi- Ho Jeong (Pusan National University)
   : Kiwao Kadokami (Kitakyushu City Inst. of Environ. Sciences)
3. The comparison study of dioxin inventory estimation.
   : Gon Ok (Pukyong National University)
   : Noriyuki Suzuki (NIES)
4. Harmonization of analytical methods for dioxin and other POPs between Korea and Japan.
   : Sam-Cwan Kim (NIER)
   : Yasuyuki Shibata (NIES)
5. Research on Effects of Organotin Pollution to Shellfish Populations at the Korean and North Japanese Coast: Current Status and a Mode of Action of Organotins.
   : Hyun-Seo Cho (Yeosu National University)
   : Toshihiro Horiguchi (NIES)

The 6th Japan-Korea Co-operative Joint Symposium (Tsukuba, 17 January 2007)

1. Harmonization of analytical methods of dioxin and other POPs between Korea and Japan.
   : Yasuyuki Shibata, Yoshikatsu Takazawa
   : Kim Sam-Cwan, Choi Jong-Woo,
2. Cooperative research on fate models on POPs.
   : Noriyuki Suzuki
   : Jun-Heon Yoon.
3. Compararison of dioxin levels in freshwater fish (Crucian Carp).
   : Kiwao Kadokami, Youko Kajiwara
   : Gi-Ho Jeong,

The 7th Korea-Japan Co-operative Joint Symposium (Gyeonju, 19 March 2008)

1. Harmonization of analytical methods of dioxin and other POPs between Korea and Japan.
   : Sam-Cwan KIM, Jong-Woo CHOI
   : Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA
2. Cooperative research on fate models on POPs.
   : Jun-Heon YOON
   : Noriyuki SUZUKI
3. Compararison of dioxin levels in freshwater fish (Crucian Carp).
   : Gi-Ho JEONG
   : Kiwao KADOKAMI, Tomomi IWAMURA
4. Environmental monitoring and risk assessment of Perfluorinated Chemicals.
   : Hyumi-Mi Kim, Hyeon-Seo Cho,
   : Norihisa TATARAZAKO, Norimitsu SAITO, Kazuaki SASAKI, .

The 8th Japan-Korea Co-operative Joint Symposium (Iwate, 5 February 2009)

1. Harmonization of Analytical Methods for Dioxin and other POPs between Japan and Korea.
   : Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA
   : Sam-Cwan KIM, Jong-Woo CHOI
2. Cooperative research on fate models on POPs.

: Noriyuki SUZUKI
: Jun-Heon YOON

3. Comparison of POPs levels in freshwater fish (Crucian carp)
: Kiwao KADOKAMI, Tomomi Iwamura
: Gi-Ho JEONG

4. Comparison of monitoring data for Perfluorinated Chemicals between Japan and Korea
: Norihisa TATARAZAKO, Norimitsu SAITO, Kazuaki SASAKI,
: Hyun-Mi KIM, Hyeon-Seo CHO

The 9th Korea-Japan Co-operative Joint Symposium (Seoul, 8 March 2010)

1. Harmonization of Analytical Methods for Dioxins and POPs/new POPs between Korea and Japan.
: Sam-Cwan KIM, Jong-Woo CHOI
: Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA

2. Cooperative research on bioaccumulation on POPs and relative chemicals
: Jun-Heon YOON
: Noriyuki SUZUKI,

3. Comparison of Polybrominated Diphenyl Ethers Levels in Fresh water fish (Crucian carp) between Korea and Japan.
: Gi-Ho JEONG, Kyung-Hee CHOI
: Kiwao KADOKAMI, Tomomi IWAMURA, Yoko KAJIWARA

4. Comparison of monitoring data for Perfluorinated Chemicals between Korea and Japan.
: Ig-Chun EOM, Jun-Heon YOON, Hyeon-Seo CHO
: Norihisa TATARAZAKO, Norimitsu SAITO, Kazuaki SASAKI

The 10th Japan-Korea Co-operative Joint Symposiu (Fukuoka, 15 February 2011)

1. Harmonization of Analytical Methods for Dioxins and POPs/new POPs between Japan and Korea
: Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA,
: Sam-Cwan KIM, Jong-Woo CHOI,

2. Cooperative research on bioaccumulation on POPs and relative chemicals
: Noriyuki SUZUKI, Takeo SAKURAI
: YOON Jun-Heon, LEE Byoung-Cheun

3. Comparison of hexabromocyclododecanes (HBCDs) levels in freshwater fish (Crucian carp) between Korea and Japan
: Kiwao KADOKAMI, Tomomi IWAMURA,
: JEONG Gi-Ho, CHOI Kyung-Hee

4. Comparison of monitoring results and toxicological data for Perfluorinated Chemicals between Japan and Korea.
: Norihisa TATARAZAKO, Kazuaki SASAKI, Norimitsu SAITO
: LEE Jae-An, CHO Hyeon-Seo

The 11th Korea-Japan Co-operative Joint Symposium (Jeju, 8 March 2012)

1. Harmonization between Korea and Japan of Analytical Methods for Dioxins and Existing/new POPs.
: Sam-Cwan KIM, Jong-Woo CHOI
: Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA,

2. Cooperative research on Bioaccumulation on POPs and related Chemicals
: Ig-Chun EOM, Byoung-Cheun LEE
: Noriyuki SUZUKI, Takeo SAKURAI

3. Comparison of POPs levels in Fresh Water Fish (Crucian carp) between Korea and Japan.
: Gi-Ho JEONG, Byoung-Cheun LEE
: Kiwao KADOKAMI, Tomomi IWAMURA,

4. Comparison of monitoring results and toxicological data for Perfluorinated Chemicals between Korea and Japan.
: Jae-An LEE, Byoung-Cheun LEE, Hyeon-Seo CHO
: Norihisa TATARAZAKO, Norimitsu SAITO, Kazuaki SASAKI

The 12th Japan-Korea Co-operative Joint Symposium (Tokyo, 21 February 2013)

1. Harmonization between Korea and Japan of Analytical Methods for Dioxins and Existing/new POPs
: Yoshikatsu TAKAZAWA
: Jong-Woo CHOI,

2. Cooperative research on bioaccumulation on POPs and related chemicals
: Takeo SAKURAI
: lg-Chun EOM

3. Comparison of perfluoro-compounds (PFCs) levels in freshwater fish (Crucian

carp) between Korea and Japan
: Kiwao KADOKAMI
: Gi-Ho JEONG
4. Comparison of monitoring results and toxicological data for Perfluorinated Chemicals between Korea and Japan
: Norihisa TATARAZAKO, Norimistu SAITO, Kazuaki SASAKI, Katsumi IWABUCHI Jae-An LEE, Hyeon-Seo CHO,

The 13th Korea-Japan Co-operative Joint Symposium (Yeosu, 7 March 2014)

1. Harmonization between Korea and Japan of Analytical Methods for Dioxins and Existing/new POPs.
: Kyung-Hee CHOI, Jong-Woo CHOI
: Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA,
2. Cooperative research on bioaccumulation on POPs and related chemicals
: Ig-Chun EOM, Byoung-Cheun LEE
: Noriyuki SUZUKI, Takeo SAKURAI
3. Comparison of the amount of Perfluoro-compound (PFCs) Accumulation in Fresh Water Fish and the Surrounding Environment Media between Korea and Japan.
: Ji-Sung RYU, Gi-Ho JEONG
: Kiwao KADOKAMI, Rento HIDAKA
4. Comparison of monitoring results and toxicological data for Perfluorinated Compounds between Korea and Japan
: Kyung-Hwa PARK, Byoung-Cheun LEE, Hyeon-Seo CHO
: Norihisa TATARAZAKO, Katsumi IWABUCHI, Masafumi ONO, Norimitsu SAITO

The 14th Japan-Korea Co-operative Joint Symposium (Iwate, 27 February 2015)

1. Harmonization between Korea and Japan of Analytical Methods for Dioxins and Existing/new POPs.
: Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA
: Kyung-Hee CHOI, Jong-Woo CHOI
2. Cooperative research on bioaccumulation on POPs and related chemicals.
: Noriyuki SUZUKI, Takeo SAKURAI
: Ig-Chun EOM, Ji-Sung RYU
3. Comparison of the amount of perfluorinated compound (PFCs) accumulation in fresh water fish and the surrounding environment media between Japan and Korea.
: Kiwao KADOKAMI, Rento HIDAKA
: Jeong-Eun OH, Ji-Sung RYU,
4. Comparison of monitoring results and toxicological data for Perfluorinated Compounds between Korea and Japan.
: Norihisa TATARAZAKO, Masafumi ONO, Katsumi IWABUCHI
: Kyung-Hwa PARK, Hyeon-Seo CHO

The 15th Korea-Japan Co-operative Joint Symposium (Busan, 4 March 2016)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
: KIM Jee-Young, CHOI Jong-Woo, CHOI Kyung-Hee
: TAKEUCHI Akinori, YAMAKAWA Akane, SHIBATA Yasuyuki
2. Cooperative research on bioaccumulation of emerging contamination in fishes
: OH Jeong-Eun OH, PARK Kyung-Hwa, LEE Jae-Woo
: SUZUKI Noriyuki, SAKURAI Takeo, TATARAZAKO Norihisa
3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
: KIM Hyuk, CHUNG In-Young, CHOI Kyung-Hee
: TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki
4. Cooperative research on analytical methods and environmental monitoring of emerging contaminants in water and sediments.
: CHO Hyeon-Seo, PARK Kyung-Hwa, LEE Jae-Woo
: IWABUCHI Katsumi, SENZAKI Norimasa, KADOKAMI Kiwao, TATARAZAKO Norihisa

The 16th Japan-Korea Co-operative Joint Symposium (Kumamoto, 22 February 2017)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
: TAKEUCHI Akinori, YAMAKAWA Akane, SHIBATA Yasuyuki
: KIM Min-Seob, CHOI Jong-Woo, CHOI Kyung-Hee
2. Cooperative research on bioaccumulation of emerging contamination in fishes

: SUZUKI Noriyuki, SAKURAI Takeo, TATARAZAKO Norihisa
: OH Jeong-Eun, PARK Kyung-Hwa, LEE Jae-Woo

3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
: TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki
: PARK Yu-Mi, CHUNG In-Young, CHOI Kyung-Hee

4. Cooperative research on analytical methods and environmental monitoring of emerging contaminants in water and sediments.
: TATARAZAKO Norihisa, KADOKAMI Kiwao, SENZAKI Norimasa, IWABUCHI Katsumi
: CHO Hyeon-Seo, PARK Kyung-Hwa, LEE Jae-Woo

The 17th Korea-Japan Co-operative Joint Symposium (Busan, 1 February 2018)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
: KIM Min-Seob, CHOI Jong-Woo, CHOI Kyung-Hee
: YAMAKAWA Akane, SHIBATA Yasuyuki

2. Cooperative research on bioaccumulation of emerging contamination in fishes.
: OH Jeong-Eun, PARK Kyung-Hwa, LEE Byoung-Cheun
: SAKURAI Takeo, SUZUKI Noriyuki, TATARAZAKO Norihisa

3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
: Kim Dong-Hoon, CHUNG In-Young
: TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki

4. Cooperative research on analytical methods and environmental monitoring of emerging contaminants in water and sediments.
: CHO Hyeon-Seo, PARK Kyung-Hwa, LEE Jin-Wuk
: IWABUCHI Katsumi, KAWAMURA Yuji, KADOKAMI Kiwao, TATARAZAKO Norihisa

The 18th Japan-Korea Co-operative Joint Symposium (Fukuoka, 20 February 2019)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
: TAKEUCHI Akinori, SHIBATA Yasuyuki
: KIM Min-Seob, CHOI Jong-Woo, KWON Sae-Yun

2. Cooperative research on bioaccumulation of emerging contamination in fishes.
: SUZUKI Noriyuki, SAKURAI Takeo, TATARAZAKO Norihisa
: CHO Hyeon-Seo, PARK Kyung-Hwa, LEE Byoung-Cheun, KIM Kyung-Tae, LEE Byeong-Woo

3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
: TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki
: Kim Young-Hee, Do Young-Sun

4. Cooperative research on environmental status PPCPs in both countries.
: MATSUMURA Chisato, YAMAMOTO Hiroshi, HAGA Yuki, YOSHIKI Ryosuke, KAWAMURA Yuji, IWABUCHI Katsumi,
: OH Jeong-Eun, PARK Kyung-Hwa, KIM Kyung-Tae, LEE Byeong-Woo, LEE Jin-Wuk

The 19th Japan-Korea Co-operative Joint Symposium (Seoul, 13 February 2020)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
: TAKEUCHI Akinori, SHIBATA Yasuyuki
: KIM Min-seob, KWON Sae-Yun, Park Jaeseon, CHOI Jong-woo

2. Cooperative research on bioaccumulation of emerging contaminants in fishes.
: SAKURAI Takeo, SUZUKI Noriyuki, TATARAZAKO Norihisa
: CHO Hyeon-Seo, PARK Kyung-Hwa, KIM Kyung-Tae, LEE Byeong-Woo

3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
: TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki
: Kim Hyunjeong, DO Young-sun

4. Cooperative research on environmental status of PPCPs in both countries.
: YAMAMOTO Hiroshi, MATSUMURA Chisato, HAGA Yuki, KAKOI Takuya, YOSHIDA Toshihiro, IWABUCHI Katsumi
: OH Jeong-eun, Dr. PARK Kyung-hwa, Mr. KIM Kyung-tae, LEE Byeong-woo

The 20th Japan-Korea Co-operative Joint Symposium (on the web hosted by NIES, Japan, 23 February 2021)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
   : TAKEUCHI Akinori, YAMAKAWA Akane, SHIBATA Yasuyuki
   : PARK Jae-Seon, KIM Min-Seob, CHOI Jong-Woo, KWON Sae-Yun
2. Cooperative research on bioaccumulation of emerging contamination in fishes.
   : SAKURAI Takeo, SUZUKI Noriyuki, TATARAZAKO Norihisa
   : CHO Hyeon-Seo, PARK Kyung-Hwa, KIM Kyung-Tae, PARK Hyung-Geun, LEE Byeong-Woo
3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
   : TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki
   : Kim Hyun-Jeong, NOH Seam
4. Cooperative research on environmental status PPCPs in both countries.
   : YAMAMOTO Hiroshi, MATSUMURA Chisato, HAGA Yuki, KAKOI Takuya, IWABUCHI Katsumi, YOSHIDA Toshihiro
   : OH Jeong-Eun, PARK Kyung-Hwa, KIM Kyung-Tae, LEE Byeong-Woo

The 21st Korea-Japan Co-operative Joint Symposium (on the web hosted by NIER, Korea, 17 February 2022)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
   : PARK Jae-Seon, KWON Sae-Yun, KIM Min-Seob
   : YAMAKAWA Akane, SHIBATA Yasuyuki
2. Cooperative research on the behavior and bioaccumulation of POPs-related and POPs-alternative chemicals in the aquatic environment.
   : CHO Hyeon-Seo, PARK Kyung-Hwa, PARK Hyung-Geun
   : SAKURAI Takeo, SUZUKI Noriyuki
3. Cooperative research on environmental monitoring of POPs and other priority pollutants.
   : Kim Hyun-Jeong, NOH Seam, LEE Su-Min
   : TAKAZAWA Yoshikatsu, NAKAYAMA Shunichi, TOBISHI Kazuhiro, KOGISO Toshitaka, SHIBATA Yasuyuki
4. Cooperative research on the monitoring of Contaminants of Emerging Concern (CECs) in the environment.
   : OH Jeong-Eun, PARK Kyung-Hwa, KIM Kyung-Tae
   : MATSUMURA Chisato, SAKAMOTO Kazumasa, KAKOI Takuya, HASEGAWA Hitomi, NISHINO Takahiro, KATO Mika, TAHARA Ruriko, NAGAHORA Shinichiro, YAMAMOTO Hiroshi

The 22nd Japan-Korea Co-operative Joint Symposium (on the web hosted by NIES, Japan, 16 February 2023)

1. Mercury isotope analysis as a new tool to support Minamata Convention on Mercury.
   : YAMAKAWA Akane, SHIBATA Yasuyuki
   : PARK Jae-Seon, KWON Sae-Yun, KIM Eun-Mi
2. Cooperative research on the behavior and bioaccumulation of POPs-related and POPs-alternative chemicals in the aquatic environment..
   : SAKURAI Takeo, SUZUKI Noriyuki
   : CHO Hyeon-Seo, PARK Kyung-Hwa, PARK Hyung-Geun,
3. Cooperative research on innovative monitoring technique of POPs and other priority pollutants.
   : TAKAZAWA Yoshikatsu, SHIBATA Yasuyuki, NAKAYAMA Shunichi, TOBISHI Kazuhiro, KOGISO Toshitaka,
   : Kim Hyun-Jeong, PARK Yu-Mi, NOH Seam
4. Cooperative research on the monitoring of contaminants of emerging concern (CECs) in the environment.
   : YAMAMOTO Hiroshi, MATSUMURA Chisato, SAKAMOTO Kazumasa, KAKOI Takuya, TAHARA Ruriko, NAGAHORA Shinichiro, NISHINO Takahiro, KATO Mika, HASEGAWA Hitomi
   : OH Jeong-Eun, PARK Kyung-Hwa, KIM Kyung-Tae
   : TATARAZAKO Norihisa, KADOKAMI Kiwao, SENZAKI Norimasa, IWABUCHI Katsumi
   : CHO Hyeon-Seo, PARK Kyung-Hwa, LEE Jae-Woo

A-2a. Korean researchers and affiliations who participated in each project

Name	Affiliation	Project No
Hyeonseo CHO	Chonnam National University	I–6, II–4, III–4, IV–4, V–2, V–4, VI–2, VII–2
Jongwoo CHOI	National Institute of Environmental Research	II–1, III–1, IV–1, V–1, VI–1
Kyunghee CHOI	National Institute of Environmental Research	I–5, III–3, IV–1, V–3
Inyoung CHUNG	National Institute of Environmental Research	V–3
Kyuhyuck CHUNG	Sungkyunkwan University	I–3
Youngsun DO	National Institute of Environmental Research	VI–3
Igchun EOM	National Institute of Environmental Research	III–2, III–4, IV–2, IV–4
Giho JEONG	Pusan National University	I–2, II–3, III–3, IV–3
Donghoon KIM	National Institute of Environmental Research	VI–3
Hyuk Kim	National Institute of Environmental Research	V–3
Hyunjeong KIM	National Institute of Environmental Research	VII–3
Hyunmi KIM	National Institute of Environmental Research	I–5, II–4
Jeeyoung KIM	National Institute of Environmental Research	V–1
Kyungtae KIM	National Institute of Environmental Research	VI–2, VI–4, VII–4
Minseob KIM	National Institute of Environmental Research	V–1, VI–1, VII–1
Samcwan KIM	National Institute of Environmental Research	I-7, II–1,III-1, IV-1
Younghee KIM	National Institute of Environmental Research	VI–3
Saeyun KWON	Pohang University of Science and Technology	VII–1
Byeongwoo LEE	National Institute of Environmental Research	VI–2, VII–4
Byoungcheun LEE	National Institute of Environmental Research	III–2, III–3, III–4, IV–2, IV–3, IV–4, V–2, V–4, VI–2
Dongsoo LEE	Seoul National University	I–1
Jaean LEE	National Institute of Environmental Research	III–4, IV–4, V–4
Jaewoo LEE	National Institute of Environmental Research	V–2
Moonsoon LEE	National Institute of Environmental Research	I–5
Seam NOH	National Institute of Environmental Research	VII–3
Jeongeun OH	Pusan National University	IV–3, V–2, VI–4, VII–4
Gon OK	Pukyong National University	I–4
Hyunggeun PARK	National Institute of Environmental Research	VI–2, VII–2
Jaeseon PARK	National Institute of Environmental Research	V–1, VI–1, VII–1
Kwangsik PARK	Dongduk Women's University	I–5
Kyunghwa PARK	National Institute of Environmental Research	IV–4, V–2, VI–2, VI–4, VII–2, VII–4
Yumi PARK	National Institute of Environmental Research	V–3
Jisung RYU	National Institute of Environmental Research	IV–2, IV–3, IV–4, V–2
Junheon YOON	National Institute of Environmental Research	II–2, III–2, III–4, IV–4

A-2b. Japanese researchers and affiliations who participated in each project

Name	Affiliation	Project No
Yuki HAGA	Hyogo Prefectural Institute of Environmental Sciences	VI–4
Hitomi HASEGAWA	Nagoya City Institute for Environmental Sciences	VII–4
Rento HIDAKA	The University of Kitakyushu	IV–3
Toshihiro HORIGUCHI	National Institute for Environmental Studies	I–6
Katsumi IWABUCHI	Iwate Prefectural Research Institute for Environmental Sciences and Public Health	IV–4, V–4, VI–4
Tomomi IWAMURA	The University of Kitakyushu	II–3, III–3
Hisato IWATA	Ehime University	I–3
Kiwao KADOKAMI	Kitakyushu City Institute of Environmental Sciences	I–2
Kiwao KADOKAMI	The University of Kitakyushu	II–3, III–3, IV–3, V–4
Yoko KAJIWARA	Kitakyushu City Institute of Environmental Sciences	I–2, III–3
Takuya KAKOI	Hyogo Prefectural Institute of Environmental Sciences	VI–4, VII–4
Mika KATO	Tokyo Metropolitan Research Institute for Environmental Protection	VII–4
Yuji KAWAMURA	Iwate Prefectural Research Institute for Environmental Sciences and Public Health	V–4, VI–4
Toshitaka KOGISO	Fukuoka Institute of Health and Environmental Sciences	VII–3
Chisato MATSUMURA	Hyogo Prefectural Institute of Environmental Sciences	VI–4, VII–4
Shinichiro NAGAHORA	Hokkaido Research Organization	VII–4
Shunichi NAKAYAMA	Kanagawa Environmental Research Center	VII–3
Takahiro NISHINO	Tokyo Metropolitan Research Institute for Environmental Protection	VII–4
Masafumi ONO	Iwate Prefectural Research Institute for Environmental Sciences and Public Health	IV–4
Norimistu SAITO	Iwate Prefectural Research Institute for Environmental Sciences and Public Health	II–4, III–4, IV–4
Kazumasa SAKAMOTO	Hyogo Prefectural Institute of Environmental Sciences	VII–4
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