Stockholm Convention on Persistent Organic Pollutants

National Implementation Plan 2019 Implementation Results

Environmental Protection Administration of the Executive Yuan

Ministry of Health and Welfare

Council of Agriculture of the Executive Yuan

Ministry of Economic Affairs

Customs Administration of the Ministry of Finance

Occupational Safety and Health Administration of the Ministry of Labor

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National Implementation Plan
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Abstract

"Stockholm Convention on Persistent Organic Pollutants" (referred to as POPs Convention) is an international convention that protects human health and the environment from the hazards of Persistent Organic Pollutants (POPs). The goal is to eliminate or limit the production, use, and emission reduction of persistent organic pollutants. The Convention has taken effect since May 17, 200(D) As of the end of 2019, the POPs listed under the Convention are divided into pesticides, industrial chemicals and unintentional derivatives, and there is a total of 30 kinds.

Although our country is not a party to the convention, to integrate our POPs management with the international convention and progressively achieve our vision of "effectively managing chemical substances and building a healthy and sustainable environment", the Environmental Protection Administration of the Executive Yuan (hereinafter referred to as EPA) invited Council of Agriculture (hereinafter referred to as COA), the Ministry of Health and Welfare (hereinafter referred to as MOHW), the Ministry of Economic Affairs, the Ministry of Finance and the Ministry of Labor jointly formulated our "Stockholm Convention on Persistent Organic Pollutants National Implementation Plan" (National implementation plan, NIP), the first version was approved by the Executive Yuan on July 3, 200(H) In recent years, it has been revised continuously to keep up with the trend of the convention on a rolling basis, as a foundation for domestic implementation.

To help our people understand the specific effects of the POPs management in our country, the EPA has compiled the implementation results by the NIP formulation team members in 2019 regarding regulatory management, monitoring of environment, biological substances and commercial products, and public education and advocacy etc. The summary is as follows:

I. Domestic POPs related regulations management

The POPs management in our country is under the responsibility of environmental protection, agriculture, health, economics, finance and labor

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(I) EPA uses the relevant laws and regulations to 「Toxic and Concerned Chemical Substances Control Act」「Environmental Agents Control Act」「Air Pollution Control Act」「Water Pollution Control Act」「Waste Disposal Act」「Soil and Groundwater Pollution Remediation Act」「Drinking Water Management Act」 to manage POPs.

(II) COA uses the relevant laws and regulations to 「Agro-Pesticides Management Act」「Fisheries Act」「Veterinary Drugs Control Act」「Feed Control Act」「Agricultural Production and Certification Act」 to manage POPs.

(III) MOHW uses「Act Governing Food Safety and Sanitization」to manage POPs.

(IV) The Ministry of Economic Affairs uses the relevant laws and regulations to 「Statute for Industrial Innovation」 and 「Factory Management Act」 to manage POPs, and counsel the factories to achieve reduction goal with source reduction, cleaner production, end-of-pipe control technology and waste recycle. Competent authorities for goods (EPA, MOHW, COA, etc.) should manage POPs at the border in accordance with their laws and regulations, and send letters to the Bureau of Foreign Trade of the Ministry of Economic Affairs (hereinafter referred to as MOEA) to add and revise regulations on the import and export of goods, and the Bureau of Foreign Trade of the Ministry of Economic Affairs publicizes the relevant names of goods and regulations od import and export in accordance with 「Regulations Governing Import of Commodities」 and 「Regulations Governing Export of Commodities」 and compiles 「Consolidated List of Commodities for Import Examination Assisted by Customs」 or 「Consolidated List of Commodities for Export Examination Assisted by Customs」. When the competent authorities of goods have the need to manage the export and import of goods at the border, but there is no relevant law, the Bureau of Foreign Trade of the Ministry of Economic Affairs in accordance with the regulations in the 「Foreign Trade Act」 and the 「Enforcement Rules of the Foreign Trade Act」 consults with the competent authorities (Customs Administration of the Ministry of Finance, Ministry of Economic Affairs Industrial

Development Bureau etc.） to publicize the inclusion of the goods into the「Consolidated List of Commodities Subject to Import Restriction」or the「Consolidated List of Commodities Subject to Export Restriction」.

(V) The Customs Administration of the Ministry of Finance in accordance with the「Regulations for Customs Administration of Import and Export Trade」cooperates with various competent authorities to implement control and inspection of imported and exported goods.

(VI) The Occupational Safety and Health Administration of the Ministry of Labor uses the "Occupational Safety and Health Act" to jointly strengthen the source management of chemicals and take appropriate measures to reduce the impact on labor.

II. EPA Environmental media monitoring results

(I) River sediments and fish bodies

A. Agro pesticides POPs：Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of the concentrations of agro pesticides POPs（including Aldrin, Chlordane, DDT, Dieldrin, Endrin, heptachlor, hexachlorobenzene, Toxaphene, Endosulfan）and the derivatives in 13 samples of river sediments and found the concentrations of agro pesticides POPs in most river sediments were below the method detection limit or quantitation limit, and the concentrations for all samples of river sediments were below the quality index lower limit.

B. Polychlorinated biphenyl：EPA Soil and Groundwater Remediation Fund Management Board conducted the investigation of the concentration of polychlorinated biphenyl in river sediments and found it below the quality index lower limit (0.09 mg/kg).

C. Dioxin and furan：EPA Soil and Groundwater Remediation Fund Management Board conducted the investigation of concentration in 13 samples of river sediments, with concentration range 0.185～8.700（average 3.470）ng I-TEQ/kg, and among all, the samples from Xucuogang No.1 Bridge of Laojie Creek, Huanxiang Bridge and New Ohorikei Creek of Ohorikei Creek exceeded the quality index lower limit (6.82 ng I-TEQ/kg). In addition, Bureau of Environmental

Inspection, EPA, investigated 30 river monitoring points in Kaohsiung and Pingdong area, and the distribution range of dioxin total toxic equivalent in river sediments was 0.005-5.64 WHO-TEQ/kg d.w., and the distribution range of total toxic equivalent of dioxin type polychlorinated biphenyl was 0.00003 - 0.696 ng WHO-TEQ/kg d.w.

D. Polybrominated diphenyl ether：Toxic and Chemical Substances Bureau, EPA in 2019 focused on 15 rivers and conducted the environmental distribution investigation of 25 PBDEs (including tetrabromodiphenyl ether, hexabromodiphenyl ether, heptabromodiphenyl ether, decabromodiphenyl ether)type POPs. The investigation result shows that the weight average concentration and range of PBDEs in river sediments was 17, 943（281-401, 946）ng/kg dry weight. Among 15 rivers, Erren Creek had the highest average concentration in river sediments 82, 377 ng/kg dry weight, and the next was Nankan River 78, 507 ng/kg dry weight, and there was a decreasing trend in the rivers which had relatively high value in the past, including Kaya Creek and Dianbao Creek. The weight average concentration and range of PBDEs in fish bodies was 502 (48.3-2, 359) ng/kg wet weight.

E. Hexabromobiphenyl: Toxic and Chemical Substances Bureau of EPA focused on 15 rivers and conducted the environmental distribution investigation of 5 kinds of hexabromobiphenyl in 122 samples of river sediments, and the weight average concentration and range of hexabromobiphenyl homologues in river sediments was 41.5 (0.133-2, 184) ng/kg dry weight, and the concentration in river sediments of some rivers in the rainy season was higher than that in the dry season. The average concentration, 575 ng/kg dry weight, for Erren Creek was the highest, the next was Houlong Creek 20.5 ng/kg dry weight. The weight average concentration and range of hexabromobiphenyl homologues in fish bodies was 4.39 (0.194-45.7) ng/kg wet weight, and among all the average concentration 33.2 ng/kg wet weight for Erren Creek was the highest.

F. Hexachlorobutadiene：Toxic and Chemical Substances Bureau of EPA conducted analysis for 15 rivers, and the average concentration and range for all 122 samples of river sediments was <0.05(ND-0.204) μg/kg dry weight. In dry season, the average concentration 0.054 μg/kg

dry weight for Zhonggang Creek was the highest, and one sample analysis was positive, while other rivers were negative; in rainy season, all 15 rivers were negative, indicating river sediments after flushing the environmental hexachlorobutadiene was reduced to below the quantitative range（0.05μg/kg dry weight）. The average concentration and range of hexachlorobutadiene in fish bodies from 15 rivers was <0.1 (ND-0.691) μg/kg dry weight and <0.025 (ND-0.138) μg/kg wet weight, and among all only the analytical result for fish body from Zhonggang Creek was positive, with the concentration as high as 0.691 μg/kg dry weight（0.138 μg/kg wet weight）, which indicated that the hexachlorobutadiene content and detection rate for river sediments and fish bodies were low.

G. Short-chain chlorinated paraffin：Toxic and Chemical Substances Bureau of EPA conducted analysis of SCCPs concentration in 122 samples of river sediments and 45 samples of fish bodies from 15 rivers, indicating all had SCCPs of 55.5% chlorine content more than SCCPs of 63% chlorine content. In river sediments, Erren Creek had the highest SCCPs of 55.5% chlorine content and SCCPs of 63% chlorine content, with average concentration 2.35 mg/kg dry weight and 1.66 mg/kg dry weight, respectively.

(II) Sediments from Irrigation Ditch：Bureau of Environmental Inspection of EPA investigated 30 river ditch monitoring points in Kaohsiung and Pingdong area, and found the concentration range of agro pesticides POPs was ND-1,668 ng/kg d.w., fairly low； the range of hexabromodiphenyl ether and heptabromodiphenyl ether was 0.146-163（the average was 130.2）ng/kg d.w.； the range of tetrabromodiphenyl ether and pentabromodiphenyl ether was 1.49-29, 100（the average was 790.6）ng/kg d.w.

(III) Environmental water body：Department of Environmental Monitoring and Information Management of EPA monitored 10 monitoring points of rivers and 2 monitoring points of reservoirs, and investigated organochlorine agro pesticides in water（Endrin, Heptachlor, DDT, Aldrin, Dieldrin, Toxaphene, Lindane, Endosulfan）, and found all complied with domestic standards. Bureau of Environmental Inspection of EPA investigated perfluorooctane sulfonic acid in the river water

from Sanyegong Creek, Nankan River, Saltwater Creek, Taliaokeng Creek and found the concentration N.D.(MDL=1.94ng/L)~3, 904 ng/L.

(IV) Monitoring of dioxin and furan in environmental air: Department of Air Quality Protection and Noise Control of EPA monitored dioxin in environmental air, and found the average concentration 0.021 pg I-TEQ/m^3, significant lower than the average concentration 0.089 pg I-TEQ/m^3 from 2002 and 2003, and far lower than Japanese 「environmental dioxin air quality standard」 0.6 pg WHO_{2005}-TEQ/m^3.

(V) Stationary pollution source flue：The industry conducted 449 periodic tests of dioxin from emission pipelines dioxin, and the environmental protection agencies conducted 87 audits on emission pipelines dioxin, and found 4 audits exceeding the standard, and three of them were waster fueled boilers and one was industrial waste incinerator, and they were notified and punished by the environmental protection agencies and subject to continuous improvement. Bureau of Environmental Inspection of EPA also conducted 6 times of sampling and testing of dioxin from stationary pollution sources, and all complied with the dioxin emission standards for stationary pollution sources.

(VI) Discharged water：Department of Water Quality Protection of EPA focused on the industry operating with raw materials possibly containing perfluorooctane sulfonic acid（printing and finishing industry, textile industry and chemical industry etc.） and conducted investigation of discharged water or controlled water for 10 times, and found the concentration of perfluorooctane sulfonic acid was below the method detection limit. Soil and Groundwater Remediation Fund Management Board investigated 50 optoelectronic semiconductor companies and 16 textile companies, and the results for perfluorooctane sulfonic acid in wastewater/ discharged water were ND~398 ng/L and ND~18.7 ng/L, respectively. The investigation of domestic industrial processes of dioxin pollution potential indicated that all complied with the control standard of dioxin in discharged water.

(VII) Drinking water：Department of Environmental Sanitization and Toxic Substance Management of EPA focused on domestic municipal water supply systems to conduct drinking water quality sampling and testing for Lindane and Endosulfan for 34 times（now

implemented by Department of Water Quality Protection ）, including 31 times of municipal water sampling and 3 times of simple municipal water sampling, and the results all complied with drinking water quality standard. PFOS in water from 50 water purification plants was tested and the range was ND (method detection limit 1.2 ng/L)～87 ng/L. 3 tests of drinking water quality for water purification plan were conducted, and dioxin value was ND~0.006 pg WHO-TEQ/L, and all complied with drinking water quality standard.

(VIII) Environmental soil：Soil and Groundwater Remediation Fund Management Board of EPA conducted soil tests of polybrominated diphenyl ether, PFOS, chlorinated naphthalene, pentachlorophenol, hexachlorobutadiene, dioxin and polychlorinated biphenyl in the surrounding lands of potential pollution sources and general environmental baseline content monitoring. The results for dioxin, polychlorinated biphenyl and pentachlorophenol were far lower than domestic soil pollution control standard; hexachlorobutadiene was not detected, and the average concentrations for polybrominated diphenyl ether, PFOS and chlorinated naphthalene were 38.6 μg/kg, 2.28 μg/kg, and 62.4 ng/kg, and the average concentrations for general environmental baseline content monitoring were 9.90 μg/kg, 0.575μg/kg, and 53.4 ng/kg, respectively.

(IX) Groundwater：Soil and Groundwater Remediation Fund Management Board of EPA focused on optoelectronic semiconductor and textile related industries to conduct investigation of perfluorinated compounds in groundwater. The test result of perfluorooctane sulfonic acid in groundwater from optoelectronic semiconductor industry was ND~4, 767 ng/L, and ND~171 ng/L for groundwater from textile industry.

III. Monitoring results of organism and commercial products

(I) COA

A. Crops：14,587 samples of crops of rice, vegetables and fruits were tested, and except 1 sample of pumpkin was found for Dieldrin （the edible crops on the ground have been eradicated and destroyed, but have not been introduced into the market）, the others were not found for any convention controlled organochlorine agro pesticides（detection limit：

0.01ppm）or complied with food safety and hygiene regulations. Besides, according to the historical monitoring by the environment protection agencies, and the factory data regarding the emission pipelines (chimney) from dioxin emission nonconforming plants and other factories of high pollution potential, sampling of crops was conducted on adjacent farmlands, and in 2019, 12 samples of crops were tested for dioxin and dioxin type polychlorinated biphenyl contents, and 2 samples in the results exceeded the dioxin EU fruit and vegetable action control value (0.3 pg WHO_{2005}-TEQ/g f.w.), and they were disposed and controlled by local governments, and the content of dioxin type polychlorinated biphenyl was 0.006-0.0634 pg WHO_{2005}-TEQ/g f.w, not exceeding crops action control value.

B. Feeds and feeds additives：Testing of 47 samples of feeds and feeds samples was conducted and found the detected values of all samples were below domestic control values of dioxin, furan, and polychlorinated biphenyl in feeds.

C. Edible honey products：To comply with EU requirement of health certification, 33 samples were tested and found no residual PCBs.

D. Aquatic products: 54 samples of aquatic products were tested for dioxin and polychlorinated biphenyl, and all complied with the heath standard.

(II) MOHW

A.Commercial agricultural products: 5,164 samples of commercial agricultural products were tested, and all were not found for the residual agro pesticides in the first group such as organochlorine agro pesticides, α- hexachlorocyclohexane, β- hexachlorocyclohexane, Lindane, and Endosulfan, and all met the domestic health standard.

B. Commercial foods：The analysis of contents of dioxin, furan and dioxin type polychlorinated biphenyl in 97 samples of commercial foods from Yilan and outlying islands was tested, and the weight average concentration ranges of dioxin and furan in various kinds of foods were 0.002-0.06 and 0.002-0.18 pg WHO_{05}-$TEQ_{PCDD/F}$/g fresh weight, and the average concentration ranges of dioxin type polychlorinated biphenyl were 0.0003-0.019 and 0.001-0.143 pg WHO_{05}-TEQ_{PCB}/g fresh weight respectively, and all samples complied with domestic「Management

Regulations for Foods Containing Dioxin and Polychlorinated Biphenyl」.

C. Ministry of Economic Affairs：According to CNS 14729「Test method for pentachlorophenol preservatives in wood」, 20 samples of wood products from market were tested, including composite wood flooring, laminated veneer lumber, general plywood, medium density fiberboard, and decorative glulam, for pentachlorophenol type preservatives, and all 20 samples were not detected for any pentachlorophenol and pentachlorophenol sodium(all method detection limits were 0.1 kg/m^3).

IV. Public education advocacy

(I) A.EPA in recent years held several seminars or forums about persistent organic pollutants（including dioxin）, and completed the editing of「Handbook of Investigation Results of Environmental Distribution of Toxic Chemicals」and 「Chemical Substances in Daily Life」, and built the website of 「persistent organic pollutants」 and Facebook page of 「Chem Life」and the website of「Investigation Information of Environmental Distribution of Toxic Chemicals」, to increase domestic public understanding of POPs.

(II) In recent years, MOHW has announced information and activities through news and websites to enhance the public understanding of government actions, the risk of dioxin in diet and how to maintain diet safety. And through health risk communication activities, the goal of public health education advocacy was achieved, and through the implementation of the resident health care plan, the actual needs of the people were understood, individual consultations were provided, and the independent health care ability was enhanced. During 2019, the Health Promotion Administration continued to care for patients with oil disease, and provided necessary health education, health information and consultation services.

(III) COA conducted various kinds of education and advocacy for the safety and quality management of agricultural products through relevant websites or agricultural production and marketing classes, professional gatherings, and other occasions. The contents include the production and marketing record system of agricultural products, product safety

inspections, and encouraging farmers to pick up straw and chop them and bury them on site, and promote application of organic fertilizer containing straw decomposing bacteria and other related information.

(IV) The Ministry of Economic Affairs established the website of "Industry Green Technology Information", which provides various types of assistance of cleaner production, environmental protection technologies and regulations for various industries, and assistance in adopting effective cleaner production technologies for various industries, to improve environmental safety, and build an industrial environment for sustainable use of recyclable resources.

(V) Occupational Safety and Health Administration of the Ministry of Labor is responsible for establishing hazard identification information for hazardous chemicals that workers may be exposed to and continues to strengthen the advocacy of chemical hazards in the workplace. At present, to protect the worker's"right to know'"about hazardous chemicals, in accordance with the United Nations Globally harmonized system for classification and labelling of chemicals (GHS), examples of labels and safety data sheets for hazardous chemicals were prepared and related education and training tools were also built on the GHS website as references for the users.

Although our country is not a party to Stockholm Convention, in recent years, through continuous attention to its latest developments, inter-ministerial cooperation and keeping up with international trends, we have promoted the management of POPs related to our "Stockholm Convention on Persistent Organic Pollutants National Implementation Plan", and established a knowledge website, conducted seminars and education advocacy to promote the public awareness of the potential impact of persistent organic pollutants on the environment and human health, and as of the end of 2019, for the POPs listed under the Convention, our country has implemented the management mechanism through the "Toxic and Concerned Chemical Substances Control Act", "Agro-Pesticides Management Act" and related laws and regulations. In addition, our country also conducts pollution audits and control, control and investigation of environment and food, monitoring and R&D technologies, to reduce environmental pollution risks and ensure a healthy living environment

for the people. In the future, we will continue to integrate various ministries to effectively manage chemical substances and move towards a healthy and sustainable environment.

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I. Preface

Persistent organic pollutants (POPs) are highly toxic, bioaccumulative, long-distance migratory, and difficult to decompose in the environment. They may harm human body through food chain, which has caught the attention of many countries in the world. Under the leadership of the United Nations Environment Programme (UNEP), more than 100 countries formally signed the "Stockholm Convention" on May 23, 2001（hereinafter referred to as 「POPs Convention」）. The Convention officially came into effect on May 17, 200(D) As of the end of 2019, there are 30 substances controlled under the Convention, including Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, hexachlorobenzene, Mirex, Toxaphene, DDT, polychlorinated biphenyl, dioxin, furan, α- hexachlorocyclohexane, β-hexachlorocyclohexane, hexabromodiphenyl ether and heptabromodiphenyl ether, tetrabromodiphenyl ether and pentabromodiphenyl ether, chlordecone, hexabromobiphenyl, Lindane, pentachlorobenzene, perfluorooctane sulfonic acid and its salts and perfluorooctane sulfonate fluoride, Endosulfan, hexabromocyclododecane, chlorinated naphthalene, hexachloro-1, 3-butadiene, pentachlorophenol and its salts and esters, decabromodiphenyl ether, short-chain chlorinated paraffin, perfluorooctanoic acid and Dicofol. The purpose is to adopt effective measures to reduce and (or) eliminate the release and emission of POPs to protect human health and living environment.

After the signing of the POPs Convention, the contracting parties have begun planning the control operations in accordance with Article 7 of the Convention. Although our country is not a party to the Convention, to show our active efforts in POPs control, and to align our POPs management with the international Convention, and progressively achieve our vision of “effectively managing chemical substances and building a healthy and sustainable environment", our country formulated the domestic “Stockholm Convention on Persistent Organic Pollutants National Implementation Plan” (National Implementation Plan, NIP)（approved by the Executive Yuan on July 3, 2008）. In recent years, the revision is made on a rolling basis with the control trend under the Convention, as the basis for domestic implementation.

In addition, in accordance with Article 15 of the Convention, each party should submit a national report to the General Assembly every four years to present the measures they have implemented to fulfill the

responsibilities under the Convention and the implementation results in various aspects. Although our country is not a contracting party, to comply with the international management trend, EPA has investigated, collected and compiled the implementation results by NIP formulation team members regarding the substances controlled under the Convention up to 2019, including「Current status of regulatory management」「Monitoring results for environmental media」「Monitoring results of organism and commercial products」 and 「Other implementation results」. I hope that this report will make our people aware of the relevant implementation results and actions by our government on POPs management, and work together to reduce the hazards of toxic substances.

II. Status of regulatory management

(I). Regulatory basis

The POPs management system in my country is under the ministries of environmental protection, agriculture, health, economy, finance, and labor. The regulatory basis for the management under environmental protection agencies includes "Toxic and Concerned Chemical Substances Control Act", "Environmental Agents Control Act", "Air Pollution Control Act", "Water Pollution Control Act", "Waste Disposal Act", "Soil and Groundwater Pollution Remediation Act" and "Drinking Water Management Act" And other laws and regulations.

The regulatory basis for the management under agriculture agencies includes「Agro-Pesticides Management Act」「Fisheries Act」「Veterinary Drugs Control Act」「Feed Control Act」「Agricultural Production and Certification Act」.

The regulatory basis for the management under health agencies includes「Act Governing Food Safety and Sanitization」.

The regulatory basis for the management under economic affair agencies includes「Statute for Industrial Innovation」and「Factory Management Act」and counseling the factories to achieve reduction goal with source reduction, cleaner production, end-of-pipe control technology and waste recycle. Competent authorities for goods (EPA, MOHW, COA, etc.) should manage POPs at the border in accordance with their laws and regulations, and send letters to the Bureau

of Foreign Trade of the Ministry of Economic Affairs (hereinafter referred to as MOEA) to add and revise regulations on the import and export of goods, and the Bureau of Foreign Trade of the Ministry of Economic Affairs publicizes the relevant names of goods and regulations od import and export in accordance with 「Regulations Governing Import of Commodities」and「Regulations Governing Export of Commodities」and compiles「Consolidated List of Commodities for Import Examination Assisted by Customs」or「Consolidated List of Commodities for Export Examination Assisted by Customs」. When the competent authorities of goods have the need to manage the export and import of goods at the border, but there is no relevant law, the Bureau of Foreign Trade of the Ministry of Economic Affairs in accordance with the regulations in the 「Foreign Trade Act」and the「Enforcement Rules of the Foreign Trade Act」 consults with the competent authorities（Customs Administration of the Ministry of Finance , Ministry of Economic Affairs Industrial Development Bureau etc.）to publicize the inclusion of the goods into the 「Consolidated List of Commodities Subject to Import Restriction」or the 「Consolidated List of Commodities Subject to Export Restriction」.

Customs Administration of the Ministry of Finance, mainly according to 「Regulations for Customs Administration of Import and Export Trade」, collaborates with various competent authorities to implement control and inspection of imported and exported goods.

Occupational Safety and Health Administration of the Ministry of Labor, according to「Occupational Safety and Health Act」, establishes hazard identification information for hazardous chemicals that workers may be exposed to, strengthen chemical source management, and take appropriate measures to reduce the impact on labor

(II). Initial 12 POPs under the Convention

For the initial 12 POPs under the Convention, except that dioxin and furan are unintentional derivatives, by-products from manufacturing processes, which need assistance with source reduction and clean production, end-of-pipe control technology, and waste recycle, and implementation of emission control standards to reduce the generation of dioxin and furan, our country has included them in「Toxic and Concerned Chemical Substances Control Act」「Agro-Pesticides Management Act」

and 「Environmental Agents Control Act」 to implement control, and prohibition of use, or unregistered use, with the details of management status in Table 1

In the addition and revision of 2019 regulations, Department of Water Quality Protection of EPA revised the“Discharged water standard" on April 29, 2019 to strengthen the control of dioxin in discharged water, and revised the applicable conditions of the waste incineration facilities, not limited to those who treat and produce wastewater entering the wastewater treatment facility. In line with the industry classification and definition by the Water Pollution Control Act, the steam supply industry was added. Based on the process of producing steam by the industry, the wastewater produced from the wet treatment of waste gas contains dioxin and other pollutants, and therefore the applicable items of dioxin standard were formulated.

According to the statistics on import and export trade of the Republic of China provided by the Customs Administration of the Ministry of Finance, in the first group of POPs in 2019, dioxin and furan were unintentionally derived chemical substances and by-products of manufacturing processes；the imports for Aldrin, Chlordane, Heptachlor, DDT, Dieldrin, Endrin, hexachlorobenzene, Mirex, Toxaphene and polychlorinated biphenyl were all less than 1 kg, and the exports were all 0 kg. Besides, according to the reported data of toxic chemicals from Toxic and Chemical Substances Bureau of EPA, there has been no production of 9 kinds of domestic organochlorine agro pesticides and polychlorinated biphenyl, and the import of polychlorinated biphenyl was 0.02931 kg, and the imports of other organochlorine agro pesticides were 0-0.0014 kg, which were all used for research, education and tests.

(III). Second group of 9 POPs under the Convention

Our country has included the control of the second group of 9 POPs under the Convention in our「Toxic and Concerned Chemical Substances Control Act」「Agro-Pesticides Management Act」 and 「Environmental Agents Control Act」. Among the controlled toxic chemical substances in the 「Toxic and Concerned Chemical Substances Control Act」, except that pentabromodiphenyl ether, 2, 2', 4, 4'- tetrabromodiphenyl ether, 2, 2', 4, 4', 5, 5'-hexabromodiphenyl ether, 2, 2', 4, 4', 5, 6'-hexabromodiphenyl

ether, 2, 2', 3, 3', 4, 5', 6- heptabromodiphenyl ether, 2, 2', 3, 4, 4', 5', 6-heptabromodiphenyl ether, perfluorooctane sulfonic acid and lithium salts of perfluorooctane sulfonic acid can still be used for prescribed purposes, others are completely prohibited from manufacture, import, sale and use, except for experiment, research, and education users. For detailed management status, see Table 2

In the addition and revision of regulations in 2019, Bureau of Standards, Metrology and Inspection, MOEA revised and publicized CNS 15290「Textile product safety regulations (general requirements)」national standard, adding that perfluorooctane sulfonic acid(PFOS) in textile products or coating materials cannot exceed 1 $\mu g/m^2$, as a public reference, for consumers feel safer, and completed the publicization that products such as wireless chargers and electronic toilet seats are subject to tests., and the tests added the content labeling requirement for restricted substances in CNS 15663 Section 5（lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ether）.

For the export of chemical substances, according to the statistics on import and export trade of the Republic of China provided by Customs Administration, MOF, in 2019 the imports of α- hexachlorocyclohexane and β- hexachlorocyclohexane（including Lindane）, polybrominated diphenyl ether（including tetra- to heptabromodiphenyl ether）, chlordecone, hexabromobiphenyl, pentachlorobenzene, perfluorooctane sulfonic acid were all under 1 kg, and the exports were 0 kg. Besides, according to the reported toxic chemical substances by the Toxic and Chemical Substances Bureau of EPA, there has been no production of the second group of 9 POPs controlled under the Convention, and the imports were 0-0.10255 kg, which were all for research, education and tests.

(IV). Third group of 1 POPs under the Convention （Endosulfan）

EPA in 2011 included Endosulfan（industrial grade Endosulfan）, α-Endosulfan, β- Endosulfan, and Endosulfan sulfate into the control by「Toxic and Concerned Chemical Substances Control Act」. COA on December 30, 2011, according to「Agro-Pesticides Management Act」,

publicized that Endosulfan agro pesticides Endosulfan agro pesticides have been banned from manufacture, processing or import since January 1, 2012, and at the same time banned the permit of related agro pesticides, and prohibited their selling and use since January 1, 2014, and many available alternative agents, including many active ingredients and agents like Jiabaofu, Jiafosong, Tofosone, Tofolol, Ethanasone, Finhuali, Taossong, and Taosnin. At present, Endosulfan is completely prohibited from manufacture, import, sale, and use, except for experiment, research, and education users. For detailed management status, see Table 3

For the import and export of chemical substances, according to the statistics on import and export trade of the Republic of China provided by the Customs Administration of the Ministry of Finance, in 2019 the imports of Endosulfan（industrial grade Endosulfan）, α−Endosulfan, β-Endosulfan and Endosulfansulfate were under 1 kg, and the imports were 0 kg. Besides, according to the reported data of toxic chemical substances from the Toxic and Chemical Substances Bureau of EPA, there was no domestic production, and the import was 0.00035-0.00075 kg, all used for research, education, and experimental purposes.

(V). Fourth group of 1 POPs under the Convention (hexabromocyclododecane）

In 2014, our country included hexabromocyclododecane, α-hexabromocyclododecane, β-hexabromocyclododecane and γ-hexabromocyclododecane in the management of Class 1 toxic chemical substances under the「Toxic and Concerned Chemical Substances Control Act」, and specified the intended use is research, experiment, education, manufacture of expandable polystyrene (EPS), manufacture of extruded polystyrene (XPS). For detailed management status, see Table 4

For the import and export of chemical substances, according to the statistics on import and export trade of the Republic of China provided by the Customs Administration of the Ministry of Finance, in 2019 the import of hexabromocyclododecane was under 1 kg, and the export was 0 kg. Besides, according to the reported data of toxic chemical substances from the Toxic and Chemical Substances Bureau, there was no domestic production, and the import was 0.00001-0.001 kg, used in the manufacture

and research, education and experiment of expanded polystyrene.

(VI). Fifth group of 3 POPs under the Convention（chlorinated naphthalene , hexachloro-1, 3 butadiene, pentachlorophenol and its salts, esters）

Our country has included chlorinated naphthalene （containing 2-8 chlorine atoms）, hexachloro-1, 3-butadiene, pentachlorophenol and pentachlorophenol sodium in the management under the「Toxic and Concerned Chemical Substances Control Act」, and except that chlorinated naphthalene can still be used for the prescribed purposes, all others are prohibited from manufacture, import, sale and use. For detailed management status, see Table 5

In the addition and revision of regulations, on March 5, 2019, responding to international trends, the Toxic and Chemical Substances Bureau of EPA revised the operation management of a controlled toxic chemical substance, hexachloro-1, 3-butadiene, according to the「Toxic and Concerned Chemical Substances Control Act」and prohibited it from manufacture, import, sale and use, but not limited to experiment, research, and education users.

For the import and export of chemical substances, according to the statistics on import and export trade of the Republic of China provided by the Customs Administration of the Ministry of Finance, in 2019 the imports of pentachlorophenol and its salts were under 1 kg, and the export was 0 kg. Besides according to the reported data of toxic chemical substances from the Toxic and Chemical Substances Bureau of EPA, there was no production of the fifth group of 3 POPs under the Convention, and the import was 0-0.0052 kg, used for research, education and experiment.

(VII). Sixth group of 2 POPs under the Convention （decabromodiphenyl ether, short-chain chlorinated paraffin）

In 1999, according to the「Toxic and Concerned Chemical Substances Control Act」, our country includes decabromodiphenyl ether in the list of Class 4 toxic chemical substances, and to cope with the management trend under the Convention, on March 5, 2019, according to the「Toxic and Concerned Chemical Substances Control Act」, the Toxic and Chemical

Substances Bureau of EPA revised decabromodiphenyl ether as Class 1 toxic chemical substance and Class 2 toxic chemical substance, and revised the control concentration to 1%, and the mass operation standard 50 Kg. At the same time, according to the 「Toxic and Concerned Chemical Substances Control Act」, it newly publicized short-chain chlorinated paraffin as Class 1 toxic chemical substance, with control concentration 1% and mass operation standard 100 kg, and which is prohibited from use in toys and children products, except 10 uses in experiment, research and education. For detailed management status, see Table 6

For the import and export of chemical substances, according to the statistics on import and export trade of the Republic of China provided by the Customs Administration of the Ministry of Finance, in 2019 the import of decabromodiphenyl ether was about 4 kg, and there was no export；according to the reported data of toxic chemicals substances from the Toxic and Chemical Substances Bureau of EPA, there was no domestic production and import of short-chain chlorinated paraffin, and there was no production of decabromodiphenyl ether, while its import was 0.00001 kg, for uses in research, experiment, and education.

Table 1 Current status of domestic regulatory management for the initial group of 12 POPs under the Convention

	Chemical substance	Regulatory agency	Domestic management status
A.	polychlorinated biphenyl (PCBs)	EPA	(A) Since 1988, according to the 「Toxic and Concerned Chemical Substances Control Act」, they have been prohibited from manufacture, import, sale and use in foods. (B) Since 2001, according to the 「Toxic and Concerned Chemical Substances Control Act」with publicization, they have been prohibited extensively from uses, but experimentation, research and education users are not restricted. Capacitors or transformers containing polychlorinated biphenyl 1000 ppm (0.1%) must be discontinued and must be declared discarded and should be properly disposed in accordance with the relevant regulations of the "Waste Disposal Act". (C) Capacitors or transformers containing polychlorinated biphenyl should be properly disposed in accordance with the 「Waste Disposal Act」 and 「Methods and Facilities Standards for the Storage, Clearance and Disposal of Industrial Waste」. (D) Formulate control standards or index in 「Soil pollution control standards」「Discharged water standards」「Classification, management and use restriction for river sediments quality index」「Types and limits for hazardous substances prohibited from entering groundwater」.
		MOHW	(A) According to the 「Act Governing Food Safety and Sanitization」, formulate 「Limit standard of polychlorinated biphenyl in foods」. (B) According to the 「Patients of Oil Disease Healthcare Services Act」, formulate 「Criteria for abnormal blood concentration of polychlorinated biphenyl (PCBs) and polychlorinated furan (PCDF)」.
		Ministry of Economic Affairs	(A) Enter the required code 「111」 According to the 「Foreign Trade Act」 announcement, include the 「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B) Output the required code 「533」 According to the 「Regulations Governing Export of Commodities」 announcement, include 「Consolidated List of Commodities for Export Examination Assisted by Customs」 and exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.
B.	Chlordane (Chlordane)	COA	Non-domestic registered agro pesticides ingredients cannot be used for agro pesticides.
		EPA	(A)Since 1988, according to the 「Toxic and Concerned Chemical Substances Control Act」 announcement, it has

	Chemical substance	Regulatory agency	Domestic management status
			been prohibited, except uses for experiment, research and education. (B)Since 1998, according to the 「Environmental Agents Control Act」 announcement, it has been prohibited from use. (C) In 「Soil pollution control standards」「Groundwater pollution control standards」 and 「Classification, management and use restriction for river sediments quality index」, formulate control standards or index.
		MOHW	(A) Formulate the 「Residual tolerance standard for agro pesticides in animal products」 to specify that all poultry and livestock products on the market should not be detected. (B) Formulate the 「Residual tolerance standard for agro pesticides」 to specify that all agricultural products on the market should not be detected.
C.	Dieldrin (Dieldrin)	COA	In 1975, according to the 「Agro-Pesticides Management Act」, it is prohibited from use in agro pesticides.
		EPA	(A)Since 1989, according to the 「Toxic and Concerned Chemical Substances Control Act」, it is publicized and has been prohibited from use, except uses for experiment, research and education. (B) Since 1998, according to the 「Environmental Agents Control Act」 it is publicized and has been prohibited from use. (C) Formulate control standards and index in the 「Discharged water standards」「Soil pollution control standards」「Classification of surface water bodies and water quality standards」「Types and limits for hazardous substances prohibited from entering groundwater」and 「Classification, management and use restriction for river sediments quality index」.
		MOHW	(A) Formulate the 「Residual tolerance standard for agro pesticides in animal products」 to specify the residual tolerance standards for agro pesticides in various poultry products. (B) Formulate the 「Residual tolerance standard for agro pesticide」 to specify that all agricultural products on the market should not be detected.
D.	DDT (DDT)	COA	Since 1973, according to the 「Agro-Pesticides Management Act」 it has been prohibited from use in agro pesticides.
		EPA	(A)Since 1989, according to the 「Toxic and Concerned Chemical Substances Control Act」, it is publicized and has been prohibited from use, except uses for experiment, research and education. (B)Since 1998, according to the 「Environmental Agents Control Act」 it is publicized and has been prohibited from use. (C) In the「Discharged water standards」「Soil pollution control standards」「Classification of surface water bodies and water

	Chemical substance	Regulatory agency	Domestic management status
			quality standards」「Types and limits for hazardous substances prohibited from entering groundwater」 and 「Classification, management and use restriction for river sediments quality index」formulate control standards and index.
		Ministry of Economic Affairs	(A) Enter the required code「111」「801」 (a) Enter the required code「111」(CCC2903.92.20.00-9) According to the「Foreign Trade Act」, publicize and include in the「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (b) Enter the required code「801」(CCC3808.52.00.00-5) According to the「Regulations Governing Import of Commodities」, publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B)Output the required code「533」(CCC2903.92.20.00-9) According to the regulations in the「Regulations Governing Export of Commodities」, publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.
		MOHW	(A) Formulate the「Residual tolerance standard for agro pesticides in animal products」, and specify the residue limit of agro pesticides in various poultry products. (B) Formulate the「Residual tolerance standard for agro pesticides」 and specify that all agricultural products on the market should not be detected.
E.	Toxaphene (Toxaphene, camphechlor)	COA	Since 1983 according to the「Agro-Pesticides Management Act」 it has been prohibited from the use in agro pesticides.
		EPA	(A)Since 1989, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use. (C) In「Discharged water standards」「groundwater pollution control standards」「Soil pollution control standards」「Classification of surface water bodies and water quality standards」「Types and limits for hazardous substances prohibited from entering groundwater」 and 「Classification, management and use restriction for river sediments quality index」, formulate control standards or

	Chemical substance	Regulatory agency	Domestic management status
			index.
		MOHW	(A) Formulate「Residual tolerance standard for agro pesticides in animal products」, and specify that all poultry and livestock products on the market should not be detected. (B) Formulate「Residual tolerance standard for agro pesticides」and specify that all agricultural products on the market should not be detected.
F.	Endrin (Endrin)	COA	Since 1971, according to the「Agro-Pesticides Management Act」it has been prohibited from use in agro pesticides.
		EPA	(A)Since 1989, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use. (C) In「Discharged water standards」「Soil pollution control standards」「Classification of surface water bodies and water quality standards」「Types and limits for hazardous substances prohibited from entering groundwater」and「Classification, management and use restriction for river sediments quality index」formulate control standards or index.
		MOHW	(A) Formulate「Residual tolerance standard for agro pesticides in animal products」and specify the residue limit of agro pesticides in various poultry products. (B) Formulate「Residual tolerance standard for agro pesticides」and specify that all agricultural products on the market should not be detected.
G.	Heptachlor (Heptachlor)	COA	Since 1975, according to the「Agro-Pesticides Management Act」it has been prohibited from use in agro pesticides.
		EPA	(A)Since 1989, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and prohibited from use, except uses for experiment, research and education. (B)Since 1998, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use. (C) In「Discharged water standards」「Soil pollution control standards」「Classification of surface water bodies and water quality standards」「Types and limits for hazardous substances prohibited from entering groundwater」and「Classification, management and use restriction for river sediments quality index」formulate control standards or index.
		MOHW	(A) Formulate「Residual tolerance standard for agro pesticides in animal products」and specify the residue limit of agro pesticides in various poultry products.

	Chemical substance	Regulatory agency	Domestic management status
			(B) Formulate「Residual tolerance standard for agro pesticides」 and specify that all agricultural products on the market should not be detected.
H.	Aldrin (Aldrin)	COA	Since 1975, according to the「Agro-Pesticides Management Act」it has been prohibited from use in agro pesticides.
		EPA	(A) Since 1989, according to the「Toxic and Concerned Chemical Substances Control Act」 it has been prohibited from use, except use in experiment, research and education. (B) Since 1998, according to the「Environmental Agents Control Act」it has been prohibited from use. (C) In「Discharged water standards」「Classification of surface water bodies and water quality standards」「Soil pollution control standards」「Types and limits for hazardous substances prohibited from entering groundwater」 and 「Classification, management and use restriction for river sediments quality index」 formulate control standards or index.
		MOHW	(A) Formulate the「Residual tolerance standard for agro pesticides in animal products」and specify the residue limit of agro pesticides in various poultry products. (B) Formulate the「Residual tolerance standard for agro pesticides」 and specify that all agricultural products on the market should not be detected.
I.	hexachlorobenzene (HCB)	COA	(A) Non-domestic registered ingredients agro pesticides cannot be used for agro pesticides
		EPA	(A) Since 1993, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use. (C) In the「Soil pollution control standards」「Hazardous industrial waste identification standards」 and 「Classification, management and use restriction for river sediments quality index」 formulate the control standards or index.
		Ministry of Economic Affairs	(A) Enter the required code「111」 According to the 「Foreign Trade Act」publicize and include in the「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental

	Chemical substance	Regulatory agency	Domestic management status
			protection authority for customs clearance.
		MOHW	(A) Formulate the「Residual tolerance standard for agro pesticides in animal products」and specify All poultry and livestock products on the market should not be detected. (B) Formulate「Residual tolerance standard for agro pesticides」and specify that all agricultural products on the market should not be detected.
J.	Mirex (Mirex)	COA	Not registered and used domestically.
		EPA	(A) Since 2010, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use.
		MOHW	(A) Formulate the「Residual tolerance standard for agro pesticides in animal products」and specify all poultry and livestock products on the market should not be detected. (B) Formulate the「Residual tolerance standard for agro pesticides」and specify that all agricultural products on the market should not be detected.
		Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.
K.	dioxin (Dioxins), furan (Furans)	MOHW	According to the「Management regulations for foods containing dioxin and polychlorinated biphenyl」specify the limit values for dioxin and dioxin type polychlorinated biphenyl in foods.
		COA	According to the Feed Control Act clearly specify the limit standards for dioxin and dioxin and dioxin type polychlorinated biphenyl in feeds and feeds additives.
L.		EPA	Air Pollution Control Act, Waste Disposal Act, Soil and Groundwater Pollution Remediation Act, Drinking Water Management Act, Water Pollution Control Act and Environmental Agents Control Act already have emission and content control standards.

Table 2 Current status of domestic regulatory management for the second group of 9 POPs under the Convention

	Chemical substance	Regulatory agency	Domestic management status
A.	α-hexachlorocyclohexane (Alpha hexachlorocyclohexane)	COA	Since 1975, according to the 「Agro-Pesticides Management Act」 it has been prohibited from use in agro pesticides.
B.	β-hexachlorocyclohexane (Beta hexachlorocyclohexane)	MOHW	(A) Formulate the 「Residual tolerance standard for agro pesticides in animal products」 and specify that all poultry and livestock products on the market should not be detected. (B) Formulate the 「Residual tolerance standard for agro pesticides」 and specify that all agricultural products on the market should not be detected.
		EPA	(A) Since 1989, according to the 「Toxic and Concerned Chemical Substances Control Act」 it is publicized and has been prohibited from use, except uses for experiment, research and education. (B) According to the 「Environmental Agents Control Act」 it is publicized and has been prohibited from use.
		Ministry of Economic Affairs	(A) Enter the required code 「111」 According to the 「Foreign Trade Act」 publicize and include in the 「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B) Output the required code 「111」 According to the 「Foreign Trade Act」 publicize and include in the 「Consolidated List of Commodities Subject to Export Restriction」, without export permit approved by the Ministry of Economic Affairs, export is prohibited.
C.	chlordecone (Chlordecone)	COA	It is not registered and used domestically for use in agro pesticides, according to the 「Agro-Pesticides Management Act」 it is prohibited from import, sale and use.
		MOHW	(A) Formulate the 「Residual tolerance standard for agro pesticides in animal products」, all poultry and livestock products on the market should not be detected. (B) Formulate the 「Residual tolerance standard for agro pesticides」 and specify that all agricultural products on the market should not be detected.
		EPA	(A) Since 2010, according to the 「Toxic and Concerned Chemical Substances Control Act」 it is publicized and has been prohibited from use, except uses for experiment, research and

	Chemical substance	Regulatory agency	Domestic management status
			education. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use.
		Ministry of Economic Affairs	(A) Enter the required code「111」 According to the「Foreign Trade Act」publicize and include in the「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B)Output the required code「111」 According to the「Foreign Trade Act」publicize and include in the「Consolidated List of Commodities Subject to Export Restriction」, without export permit approved by the Ministry of Economic Affairs, export is prohibited.
D.	Lindane	COA	According to the「Agro-Pesticides Management Act」it is prohibited from use in agro pesticides.
		Ministry of Economic Affairs	(A) Enter the required code「111」 According to the「Foreign Trade Act」publicize and include in the「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B) Output the required code「111」 According to the「Foreign Trade Act」publicize and include in the「Consolidated List of Commodities Subject to Export Restriction」, without export permit approved by the Ministry of Economic Affairs, export is prohibited.
		MOHW	(A) According to the control under Pharmaceutical Affairs Act, there is no domestic production of drugs containing Lindane. (B) Formulate the「Residual tolerance standard for agro pesticides in animal products」and specify that the Lindane residue of all poultry products on the market should meet the standards. (C) Formulate the「Residual tolerance standard for agro pesticides」and specify that all agricultural products on the market should not be detected.
		EPA	(A) Since 1989, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and prohibited from use, except use in experiment, research and education. (B) According to the「Environmental Agents Control Act」it is publicized and has been prohibited from use. (C) In「Drinking water standards」「Discharged

	Chemical substance		Regulatory agency	Domestic management status
				water standards」「Classification of surface water bodies and water quality standards」 and 「Types and limits for hazardous substances prohibited from entering groundwater」 formulate the related standards.
E.	Commercial pentabromodiphenyl ether (C-penta-BDE)	tetrabromodiphenyl ether and pentabromodiphenyl ether	EPA	According to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education.
			Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance. (C) Publicize CNS 15663 Guidelines for reducing the content of restricted chemical substances in electrical and electronic equipment, to include the limit values and related labeling requirements for polybrominated biphenyls and polybrominated diphenyl ether.
F.	pentachlorobenzene (Pentachlorobenzene)		COA	It is not registered and used domestically, according to the「Agro-Pesticides Management Act」it is prohibited from import, manufacture, sale and use.
			MOHW	(A) Formulate the「Residual tolerance standard for agro pesticides in animal products」, all poultry and livestock products on the market should not be detected. (B) Formulate the「Residual tolerance standard for agro pesticides」and specify that all agricultural products on the market should not be detected.
			EPA	(A) Since 2010, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and prohibited from use, except uses for experiment, research and education. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been

	Chemical substance		Regulatory agency	Domestic management status
				prohibited from use.
			Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B)Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.
G.	Commercial octabromodiphenyl ether(C-octa-BDE)	hexabromodiphenyl ether and heptabromodiphenyl ether	EPA	According to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education.
			Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance. (C) Publicize CNS 15663 Guidelines for reducing the content of restricted chemical substances in electrical and electronic equipment, to include the limit values and related labeling requirements for polybrominated biphenyls and polybrominated diphenyl ether.
H.	hexabromobiphenyl(Hexabromobiphenyl)		EPA	Since 2010, according to the「Toxic and Concerned Chemical Substances Control Act」it is publicized and has been prohibited from use, except uses for experiment, research and education.

	Chemical substance	Regulatory agency	Domestic management status
		Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance. (C) Publicize CNS 15663 Guidelines for reducing the content of restricted chemical substances in electrical and electronic equipment, to include the limit values and related labeling requirements for polybrominated biphenyls and polybrominated diphenyl ether.
I.	perfluorooctane sulfonic acid and its salts type and perfluorooctane sulfonate fluoride(Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride)	EPA	(A) Since 2010, according to the「Toxic and Concerned Chemical Substances Control Act」the lithium salts of perfluorooctane sulfonate fluoride, perfluorooctane sulfonic acid, and perfluorooctane sulfonic acid have been under control with specification on the uses of lithium salts of perfluorooctane sulfonic acid, perfluorooctane sulfonic acid. (B) Since 2010, according to the「Environmental Agents Control Act」it is publicized and has been prohibited from use.
		Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」, publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local

	Chemical substance	Regulatory agency	Domestic management status
			environmental protection authority for customs clearance. (C) In 2019, revise and publicize CNS 15290「Textile product safety regulations (general requirements)」national standards, adding perfluorooctane sulfonic acid (PFOS) limit value (under 1μg/m^2) and revise test methods.

Table 3 Current status of domestic regulatory management for the third group of 1 POPs under the Convention

	Chemical substance	Regulatory agency	Domestic management status
A.	Endosulfan(Endosulfan)	EPA	(A) According to the 「Toxic and Concerned Chemical Substances Control Act」 Endosulfan（industrial grade Endosulfan）, α- Endosulfan, β-Endosulfan, and Endosulfansulfate are prohibited from use, except research, experiment and education. (B) In 「Drinking water standards」 「Discharged water standards」「Classification of surface water bodies and water quality standards」「Soil pollution control standards」「Types and limits for hazardous substances prohibited from entering groundwater」 and 「Classification, management and use restriction for river sediments quality index」 formulate the related control standards or index.
		COA	According to the 「Agro-Pesticides Management Act」 specify that 「Endosulfan」 agro pesticides since January 1, 2012, is prohibited from manufacture, processing or import. At the same time the import permits for related agro pesticides are revoked；and since April 1, 2014 they have been prohibited from sale and use.
		MOHW	(A) Formulate the 「Residual tolerance standard for agro pesticides in animal products」, all poultry and livestock products on the market should not be detected. (B) Formulate the 「Residual tolerance standard for agro pesticides」 and specify that all agricultural products on the market should not be detected.
		Ministry of Economic Affairs	(A) Enter the required code 「553」 According to the 「Regulations Governing Import of Commodities」 publicize and include in the 「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code 「533」 According to the 「Regulations Governing Export of Commodities」 publicize and include in the 「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.

Table 4 Current status of domestic regulatory management for the fourth group of 1 POPs under the Convention

	Chemical substance	Regulatory agency	Domestic management status
A.	hexabromocyclododecane(Hexabromocyclododecane)	EPA	Since 2014, according to the「Toxic and Concerned Chemical Substances Control Act」 hexabromocyclododecane, α-hexabromocyclododecane, β-hexabromocyclododecane and γ-hexabromocyclododecane have been under control with only uses in research, experiment, education and manufacture of expanded polystyrene (EPS) and extruded foamed polystyrene (XPS).
		Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.

Table 5 Current status of domestic regulatory management for the fifth group of 3 POPs under the Convention

	Chemical substance	Regulatory agency	Domestic management status
A.	chlorinated naphthalene (Chloronaphthalene)	EPA	According to the「Toxic and Concerned Chemical Substances Control Act」dichloronaphthalene to octachloronaphthalene are under control and only allowed for uses in research, experiment, education and manufacture of fluorinated naphthalene, including intermediates of octachloronaphthalene.
		Ministry of Economic Affairs	(A) Enter the required code「111」 According to the「Foreign Trade Act」and「Regulations Governing Import of Commodities」, publicize and include in the「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」, publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the

	Chemical substance	Regulatory agency	Domestic management status
			local environmental protection authority for customs clearance.
B.	hexachloro-1, 3-butadiene (Hexachlorobutadiene)	EPA	(A) According to the「Toxic and Concerned Chemical Substances Control Act」it is under control and prohibited from manufacture, import, sale and use, except for use in experiment, research and education. (B) In「Stationary pollution source air pollutant emission standards」「Hazardous industrial waste identification standards」 formulate the related control standards.
		Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」 publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」 publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.
C.	pentachlorophenol and its salts, esters (Pentachlorophenol, its salts, and esters)	EPA	(A) According to the「Toxic and Concerned Chemical Substances Control Act」, pentachlorophenol, pentachlorophenol sodium and lauric acid pentachlorobenzene ester are under control as Class 1 and Class 3 toxic chemical substances, and are prohibited from manufacture, import, sale and use, except use in experiment, research and education. (B) According to the「Environmental Agents Control Act」, pentachlorophenol and pentachlorophenol sodium are listed as prohibited components in environmental agents. (C) In「Stationary pollution source air pollutant emission standards」「Soil pollution control standards」「Classification of surface water bodies and water quality standards」「Hazardous industrial waste identification standards」「Discharged water standards」「Types and limits for hazardous substances prohibited from entering groundwater」 formulate the related standards.
		COA	Since 1983, according to the「Agro-Pesticides Management Act」pentachlorophenol sodium agro pesticides have been prohibited from manufacture and import, and since 1984 they have been prohibited from sale and use.
		MOHW	(A) According to the「Residual tolerance standard for agro pesticides」, all agricultural products on the market should not be detected for pentachlorophenol sodium agro pesticides. (B) According to the「Residual tolerance standard for agro pesticides in animal products」, all poultry and livestock products on the market should not be detected for pentachlorophenol sodium agro pesticides.
		Ministry of Econom	(A) Enter the required code「111」 According to the「Foreign Trade Act」 and「Regulations Governing Import of Commodities」, publicize and include in the

	Chemical substance	Regulatory agency	Domestic management status
		ic Affairs	「Consolidated List of Commodities Subject to Import Restriction」, without import permit approved by the Ministry of Economic Affairs, import is prohibited. (B) Output the required code「533」 according to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance.

Table 6 Current status of domestic regulatory management for the sixth group of 2 POPs under the Convention

	Chemical substance	Regulatory agency	Domestic management status
A.	decabromodiphenyl ether (Decabromodiphenyl ether)	EPA	According to the「Toxic and Concerned Chemical Substances Control Act」it is under control and prohibited from use in additives for plastic casing and parts of electrical appliances：such as heating household appliances, irons, fans, immersion heaters (direct or indirect contact with electronic components), and the parts with additive weight more than 10% are prohibited from use in clothes and toys and limited to specified use.
		Ministry of Economic Affairs	(A) Enter the required code「553」 According to the「Regulations Governing Import of Commodities」publicize and include in the「Consolidated List of Commodities for Import Examination Assisted by Customs」, importers should prepare and submit the approval documents by the competent authority for customs clearance. (B) Output the required code「533」 According to the「Regulations Governing Export of Commodities」publicize and include in the「Consolidated List of Commodities for Export Examination Assisted by Customs」, Exporters should prepare and submit the shipping documents for inspection by the local environmental protection authority for customs clearance. (C) Publicize CNS 15663 Guidelines for reducing the content of restricted chemical substances in electrical and electronic equipment, to include the limit values and related labeling requirements for polybrominated biphenyls and polybrominated diphenyl ether.
B.	short-chain chlorinated paraffin (Short-chain chlorinated paraffins)	EPA	According to the「Toxic and Concerned Chemical Substances Control Act」it is under control and prohibited from use in toys and children products, and only used for specified uses.

III. Monitoring results for environmental media

Our country has conducted monitoring and analysis of river and wetland sediment and fish body, environmental water body, soil, air, stationary pollution source flue, etc.（summary in Table 7）. For detailed monitoring results, please refer to the following description.

Table 7 Summary of investigation on environmental distribution of POPs in our country

Group of Substances under control by the Convention /POPs/environmental media		river（wetland）sediment	river（wetland）fish body	Environmental air	discharged water	drinking water	Environmental soil	stationary pollution source flue emission	Farm soil	Irrigation ditch sediment	Environmental water body
A.	Aldrin	●	●				●		●	●	●
	Dieldrin	●	●				●		●	●	●
	Chlordane	●	●				●		●	●	
	Endrin	●	●				●		●	●	●
	DDT	●	●				●		●	●	●
	Mirex	●					●		●	●	
	hexachlorobenzene	●	●				●			●	
	Heptachlor	●	●				●		●	●	●
	Toxaphene	●	●				●				●
	polychlorinated biphenyl	●	●		●		●			●	●
	dioxin	●	●	●	●	●	●	●		●	
	furan	●	●	●	●	●	●	●		●	
B.	Lindane	●	●			●	●		●		●
	α-hexachlorocyclohexane	●					●		●	●	
	β-hexachlorocyclohexane	●					●		●	●	
	chlordecone						●				
	pentachlorobenzene	●					●				
	hexabromobiphenyl	●	●								
	hexabromo and heptabromodiphenyl ether	●	●		●		●	●		●	
	tetrabromo and pentabromodiphenyl ether	●	●		●		●	●		●	

Group of Substances under control by the Convention /POPs/environmental media		river（wetland）sediment	river（wetland）fish body	Environmental air	discharged water	drinking water	Environmental soil	stationary pollution source flue emission	Farm soil	Irrigation ditch sediment	Environmental water body
	perfluorooctane sulfonic acid		●		●	●	●				●
C.	Endosulfan	●	●			●	●		●	●	●
D.	hexabromocyclododecane	●	●								
E.	chlorinated naphthalene						●				
	hexachloro-1, 3-butadiene	●	●				●				
	pentachlorophenoland its salts, esters				●		●				●
F.	short-chain chlorinated paraffin	●	●								
	decabromodiphenyl ether	●	●		●		●	●		●	●

(I). Organochlorine agro pesticides

The organochlorine agro pesticides POPs controlled under the Convention include Aldrin, Dieldrin, Chlordane, Endrin, DDT, Mirex, hexachlorobenzene, Heptachlor, Toxaphene, Lindane, hexachlorocyclohexane, chlordecone, pentachlorobenzene, Endosulfan. The monitoring results for environmental media regarding organochlorine agro pesticides are described in the following：

A. River sediment and organism

Department of Environmental Sanitization and Toxic Substance Management of EPA （now Toxic and Chemical Substances Bureau） between 2002 and 2003, completed investigation of the sediments from 22 rivers regarding organochlorine agro pesticides containing Dieldrin, Endrin, Aldrin, Lindane, DDT, hexachlorobenzene and Heptachlor in the first group of POPs controlled by the Convention, and most were not detected, indicating domestic environmental concentration was fairly low；in 2005 and 2006, the investigation started for Chlordane and Toxaphene, and found most sediments were not

detected for Chlordane, the average Chlordane concentration in fish body was＜1.0 (ND-21.8) μg/kg wet weight, the Toxaphene in sediments also dropped from the previous 50μg/kg dw to below 5 μg/kg dw, indicating the environmental concentration gradually decreased, the average Toxaphene concentration and range in fish body was 6.9 (ND-113) μg/kg wet weight；in 2013 and 2015, the river environment investigation started for Endosulfan and Mirex, indicating most river sediments were not detected for Endosulfan, or the detection value was fairly low, the Endosulfan value for all fish bodies was lower than foreign value, Mirex concentration was not high, and as of now, our country has completed investigation of 30 rivers for POPs organochlorine agro pesticides, which are summarized in Table 8 and Table 9

Besides Bureau of Environmental Inspection of EPA in 2006 tested Lindane agro pesticides in river sediments, and in 2009 started including tests of the first group of controlled substances in organochlorine agro pesticides by the Convention, such as pentachlorobenzene, hexachlorocyclohexane and Endosulfan, the distribution concentration in river sediment and fish body monitored by Bureau of Environmental Inspection during 2006-2017 was in Figure 1, and the detailed values for 2015 and 2017 are in Table 10.

In addition, in 2018 Soil and Groundwater Remediation Fund Management Board of EPA focused on the sediments from domestic rivers (including Sung Creek, Narcissus Creek, Saltwater Creek）and reservoir（Xinshan Reservoir）（35 samples in total）, and in 2019 focused on 13 samples of river sediments, and conducted the investigation of concentrations of agro pesticides POPs（including Aldrin , Chlordane, DDT, Dieldrin, Endrin, Heptachlor, hexachlorobenzene, Toxaphene, and Endosulfan）and their derivatives, and the concentrations of agro pesticides POPs in most samples of sediments were below the method detection limit or quantitation limit (Aldrin MDL=0.00025 mg/kg, Chlordane MDL=0.0005 mg/kg, DDTMDL=0.00069 mg/kg, Dieldrin MDL=0.00024 mg/kg, Endrin MDL=0.00025 mg/kg, Heptachlor

MDL=0.00025 mg/kg, hexachlorobenzene MDL=0.0144 mg/kg, Toxaphene MDL=0.00362 mg/kg and Endosulfan MDL=0.00031 mg/kg), and only in 2018 the sediments near the Yongan Bridge of Saltwater Creek and the Gongliao Bridge of Sung Creek estuary were detected for trace DDT and its derivatives, with concentrations at 0.00172 mg/kg and 0.00092 mg/kg, respectively；in 2019 the sediments near the Shuibiantou Bridge of Nankan River were detected for trace DDT and its derivatives (0.00227 mg/kg)；in 2019 the sediments near the Xin Bridge of Ohorikei Creek were detected for trace DDT and its derivatives (0.00549 mg/kg), and Heptachlor (0.00242 mg/kg)；in 2019 the sediments near the Wukong Bridge of Erren Creek were detected for trace DDT and its derivatives (0.00086 mg/kg), and the concentrations of agro pesticides POPs in all sediments were below sediment quality index lower limit.

B. Wetland sediments and organism

During 2011-2014, Bureau of Environmental Inspection of EPA investigated the concentrations of organochlorine agro pesticides in wetland sediments and organism, and the sediment concentration range was ND-11.9 μg/kg dry weight, and the organism concentration range was ND-49.7 μg/kg wet weight, and among all, the Sicao wetland had the highest value（sediment concentration range was 0.721–11.9 μg/kg dry weight, organism concentration range was 3.02 – 49.7 μg/kg wet weight）. For detailed results, see Table 11, Table 12, and Figure 2

C. Irrigation ditch sediments

According to the COA published article of 「Investigation and safety assessment of organochlorine agro pesticides residues in agricultural environment」 from 2009「Forum on Achievements Review and Future Prospects after 10 Years of Investigation of Environmental Distribution of Toxic Chemicals」, the summary of test results (see Table 13 for details) by Agricultural Chemicals and Toxic Substances Research Institute（2004）for 144 samples of irrigation ditch sediments from each special rice cultivation area shows that the percentages of detected organochlorine agro

pesticides were Aldrin (18.1%) > Hexachlorocyclohexane (6.25%) > DDT (4.86%) > Endrin (2.78%) > Heptachlor (2.08%). The average residues of agro pesticides were DDT (1.31 μg/kg) > Aldrin (0.84 μg/kg) > Hexachlorocyclohexane (0.23%) > Endrin (0.76 μg/kg) > Heptachlor (0.23 μg/kg). From the data above, it is known that the average residual organochlorine agro pesticides in samples of sediments were all below 2 μg/kg.

In the end of 2016, Soil and Groundwater Remediation Fund Management Board of EPA completed the investigation of concentrations of agro pesticides POPs（including Aldrin , Chlordane, DDT, Dieldrin, Endrin, Heptachlor, hexachlorobenzene, Toxaphene, Endosulfan）and their derivatives in 15 samples of irrigation ditch sediments, and the concentrations of agro pesticides POPs in all sediments were lower than the method detection limit or quantitation limit（Aldrin MDL = 0.00032 mg/kg, Chlordane MDL = 0.0006 mg/kg, DDT MDL = 0.00106 mg/kg, Dieldrin MDL = 0.00031 mg/kg, Endrin MDL = 0.00029 mg/kg, Heptachlor MDL=0.0003 mg/kg, hexachlorobenzene MDL = 0.0144 mg/kg, Toxaphene MDL = 0.00447 mg/kg and Endosulfan MDL = 0.00065 mg/kg）.

In 2019, Bureau of Environmental Inspection of EPA investigated 30 river and ditch monitoring points in Kaohsiung and Pingdong area, and the concentration range of agro pesticides POPs in sediments was ND-1, 668 ng/kg d.w., and the concentration was low. For the details of distribution of concentration, please see Figure 3

Table 8 Results of organochlorine agro pesticides POPs in river sediments tested by EPA over the years

river estuary		Aldrin note3	Dieldrin note3	Endrin note3	DDT note3	Lindane note3	hexachlorobenzene note4	Heptachlor note4	Chlordane note5	Toxaphene note5	Mirex note6
year		2002-2003	2002-2003	2002-2003	2002-2003	2002-2003	2003	2003	2005-2012	2006-2011	2015-2017
1	Danshui River note2	ND-3.6	ND-1.4	ND	ND	ND	-	-	ND-5.3	ND-427	
(1)	Danshui River (main)	0.94-3.4	ND	ND	ND	ND	-	-	ND-5.3	<2.0-4.7	ND-0.430
(2)	Dahan River	-	-	-	-	-	-	-	ND-<2.0	ND-9.0	ND-0.1
(3)	Xindian Creek	ND-3.6	ND-1.4	ND	ND	ND	-	-	ND-<2.0	<2.0-4.0	ND-0.204
(4)	Keelung River	-	-	-	-	-	-	-	ND-5.3	3.6-427	ND ~ 0.162
2	Nankan River	-	-	-	-	-	-	-	ND-<2.0	ND-18.6	ND-0.242
3	Kaya Creek	-	-	-	-	-	-	-	ND-<2.0	ND-159	ND ~ 0.098
4	Touqian Creek	ND-5.5	ND	ND	ND	ND	-	-	ND-<2.0	ND-3.4	ND ~ 0.196
5	Houlong Creek	ND	ND-0.51	ND	ND-0.72	ND-0.43	ND-<0.2	ND	ND	ND-3.9	ND-0.186
6	Zhonggang Creek	-	-	-	-	-	-	-	ND-<2.0	<2.0-8	ND-0.208
7	Wu Creek	ND	ND-0.31	ND	ND-0.57	ND-0.45	ND-0.54	ND-0.88	ND-<2.0	ND-8.3	ND-0.353
8	Daan Creek	ND	ND-<0.2	ND	ND	ND-0.35	ND-0.57	ND	ND-<2.0	ND-3.1	ND ~ 0.067
9	Dajia	ND-	ND	ND	ND	ND	-	-	ND-<2.0	ND-<2.0	

river estuary		Aldrin[note3]	Dieldrin[note3]	Endrin[note3]	DDT[note3]	Lindane[note3]	hexachlorobenzene[note4]	Heptachlor[note4]	Chlordane[note5]	Toxaphene[note5]	Mirex[note6]
year		2002-2003	2002-2003	2002-2003	2002-2003	2002-2003	2003	2003	2005-2012	2006-2011	2015-2017
	Creek	6.5									
10	Zhuoshui Creek	ND-2.3	ND	ND	ND	ND	-	-	ND-<2.0	ND-3.7	ND ~ 0.043
11	Beigang Creek	ND-<0.2	ND-<0.2	ND	ND	ND-0.41	ND-0.36	ND	ND-<2.0	ND-<2.0	ND ~ 0.035
12	Puzi Creek	ND-1.8	ND	ND	ND	ND	-	-	ND	3.3-91.4	ND ~ 0.392
13	Bazhang Creek	ND	ND-1.3	ND	ND-0.27	ND-0.49	ND-1.3	ND	ND	ND-9.3	ND-0.145
14	Jishui Creek	ND	ND-0.42	ND-0.95	ND-0.44	ND-0.43	ND-0.83	ND	ND	ND-<4.1	ND-0.120
15	Zengwen Creek	ND-4.1	ND	ND	ND	ND-6.8	-	-	ND	ND-3.3	ND-0.453
16	Jiangjun Creek	-	-	-	-	-	-	-	ND	11.6-154	ND ~ 0.057
17	Saltwater Creek	ND-1.6	ND-<0.2	ND-2.9	ND-1.2	ND-0.39	ND-0.46	ND-9.8	ND	ND-5.7	ND-0.129
18	Erren Creek	ND-8.4	ND	ND	ND	ND-8.3	-	-	ND-5.2	<2.0-27.3	ND
19	Dianbao Creek	-	-	-	-	-	-	-	ND-<2.0	8.1-89.1	ND
20	Kaoping Creek	ND-3.5	ND-1.1	ND	ND	ND	-	-	ND	ND-57.9	ND-0.266
21	Donggang Creek	ND-0.47	ND-0.45	ND-<0.2	ND-0.27	ND-0.46	ND-0.33	ND	ND-<2.0	<2.0-5.7	ND-0.178
22	Linbian Creek	ND	ND-<0.2	ND	ND	ND-0.36	ND-<0.2	ND	ND	ND-3.6	ND-0.087
23	Xinchung	-	-	-	-	-	-	-	ND	ND-4.25	ND

river estuary		Aldrin note3	Dieldrin note3	Endrin note3	DDT note3	Lindane note3	hexachlorobenzene note4	Heptachlor note4	Chlordane note5	Toxaphene note5	Mirex note6
year		2002-2003	2002-2003	2002-2003	2002-2003	2002-2003	2003	2003	2005-2012	2006-2011	2015-2017
	Creek										
24	Langyang Creek	ND-9.8	ND-1.0	ND	ND	ND	-	-	ND-<2.0	ND-6.4	ND
25	Hualian Creek	ND-<0.2	ND-<0.2	ND	ND	ND-<0.2	ND-<0.2	ND	ND	ND-3.0	ND-0.240
26	Xiuguluan Creek	ND	ND-<0.2	ND	ND-<0.2	ND-0.44	ND-<0.2	ND	ND-<2.0	ND-4.4	ND
27	Beinan Creek	ND	ND-<0.2	ND	ND	ND-0.40	ND-<0.2	ND	ND	ND-<2.0	ND-0.101
28	Laojie Creek	-	-	-	-	-	-	-	-	<2.0-3.2	
29	Ai River	-	-	-	-	-	-	-	-	3.0-24.9	
30	Xinhuwei Creek	-	-	-	-	-	-	-	-	<2.0-2.4	
Average value（range）		0.59 (ND-9.8)	<0.2 (ND-1.4)	<0.2 (ND-2.9)	<0.2 (ND-1.2)	<0.2 (ND-8.3)	<0.2 (ND-1.3)	0.20 (ND-9.8)	<2.0 (ND-5.3)	11.1 (ND-427)	<0.05 (ND-0.353)

Note1：concentration unit：μg/kg dry weight.

Note 2：「Danshui River system」includes the data for Danshui River main stream and the data for the three tributaries, Dahan River, Xindian Creek and Keelung River.

Note3：ND means the detected value is lower than the method detection limit. Detection limits for Aldrin, Dieldrin, Endrin, DDT, and Lindane are 0.012, 0.030, 0.026, 0.057, 0.019 μg/kg dry weight, respectively.

Note4：ND means the detected value is lower than the method detection limit. Detection limits for hexachlorobenzene and Heptachlor are 0.047, 0.062 μg/kg dry weight, respectively.

Note5：ND means the detected value is lower than the method detection limit 0.0001 mg/kg dry weight.

Note 6：ND means the detected value is lower than the method detection limit 0.012 μg/kg dry weight.

Table 9 Domestic concentration range and average value for Endosulfan in river sediment and fish body during 2013-2017

Investigated river (year)		Keelung River, Kaya Creek, Touqian Creek, Dajia Creek, Zhuoshui Creek, Beigang Creek, Puzi Creek, Jiangjun Creek, Erren Creek, Xiuguluan Creek (2013)	Nankan River, Zhonggang Creek, Holong Creek, Daan Creek, Wu Creek, Saltwater Creek , Dianbao Creek, Donggang Creek, Langyang Creek, Xinchung Creek (2014)	Danshui River main stream, Dahan River, Xindian Creek, Bazhang Creek, Jishui Creek, Zengwen Creek, Kaoping Creek, Linbian Creek, Hualian Creek, Beinan Creek (2015)
river sediment	α- Endosulfan	ND-0.628(<0.05)	ND-0.274(<0.05)	ND-0.131(<0.05)
	β- Endosulfan	ND-0.723(<0.05)	ND-0.230(<0.05)	ND-0.266(<0.05)
	Endosulfansulfate	ND-1.20(0.096)	ND-0.789(0.067)	ND-0.748(0.051)
River fish body	α- Endosulfan	ND-0.12(<0.03)	ND-0.098(<0.025)	-
	β- Endosulfan	ND-0.184(<0.03)	ND-0.119(0.032)	-
	Endosulfansulfate	ND-0.270(0.057)	ND-0.136(0.026)	-
detection limit		note2	note3	note4

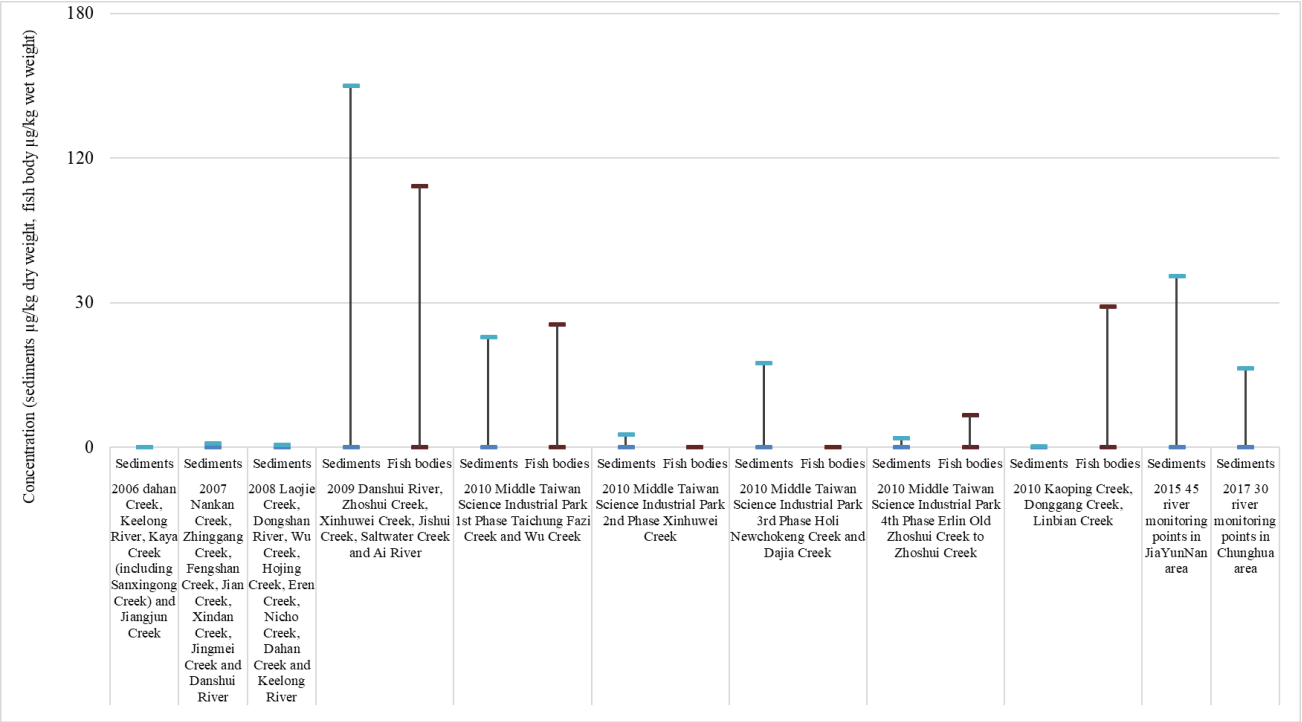
Data source：Department of Environmental Sanitization and Toxic Substance Management of EPA （now Toxic and Chemical Substances Bureau） Toxic chemical substances environmental distribution background investigation plan

Note1：unit：sediments μg/kg dry weight. Fish body unit μg/kg wet weight.

Note2：detection limits for α- Endosulfan, β- Endosulfan, and Endosulfansulfate in sediments are 0.002, 0.001, 0.001 μg/kg, respectively；α- Endosulfan, β- Endosulfan, and Endosulfansulfate in fish bodies are 0.004, 0.002, 0.004μg/kg, respectively.

Note3：detection limits for α- Endosulfan, β- Endosulfan, Endosulfansulfate in sediments are 0.022, 0.023, 0.023 μg/kg, respectively；α- Endosulfan, β- Endosulfan, and Endosulfansulfate in fish bodies are 0.005, 0.003, 0.005 μg/kg, respectively.

Note4：detection limits for α- Endosulfan, β- Endosulfan, and Endosulfansulfate in sediments are 0.005, 0.0107, 0.013 μg/kg, respectively.



sediments	ND	ND-0.7	ND-0.53	ND-150.1	ND-22.9	ND-2.65	ND-17.4	ND-1.85	ND-0.11	ND-71.1	ND-16.3
fish body	—	—	—	ND-108.4	ND-25.5	ND	ND	ND-6.60	ND-29.1	—	—

Notes：

1.During 2006~2008, the substance to be tested was Lindane.

2. During 2009~2010, the substances to be tested were hexachlorobenzene, Heptachlor, Aldrin , Chlordane, Dieldrin, Endrin, DDT, Toxaphene and Lindane (only in 2009).

3. In 2015, 45 river monitoring points in Jianan area included Sandie Creek, Puzi Creek, Bazhang Creek, Touqian Creek, Baishui Creek, Liuzhong Creek, Saltwater Creek and Erren Creek. In 2017, 30 river monitoring points in Chunghau area included four rivers, Maoluo Creek, Old Zhuoshui Creek, Yangzicuo Creek drainage system and Yuliao Creek and drainage system.

4. In 2015 and in 2017, the substances to be tested included the first group of agro pesticides controlled under the Convention, which were Aldrin , Chlordane, DDT, Dieldrin, Endrin, hexachlorobenzene, Heptachlor, and Mirex, and other organochlorine agro pesticides, which were Lindane, pentachlorophenol, hexachlorocyclohexane and Endosulfan.

5. In the figure if the test result is ND, it is expressed by 0; "—" indicates no test data.

Figure 1 Distribution of contents of organochlorine agro pesticides in river sediments and fish bodies tested by Bureau of Environmental Inspection of EPA over the years

Table 10. Results of organochlorine agro pesticides in river sediments from Jiannan and Chunghua areas tested by the Bureau of Environmental Inspection of EPA

area	agro pesticides	Aldrin	Chlordane		DDT	Dieldrin	Endrin	Heptachlor	hexachlorobenzene	Mirex	Lindane	pentachlorobenzene	α-hexachlorocyclohexane	β-hexachlorocyclohexane	α-Endosulfan	β-Endosulfan
			Trans-	Cis-												
Jiananarea（2015）	Concentration range	ND-0.00531	0.00126 - 9.05	0.00125-1.34	ND-15.9	ND-0.0572	ND-0.00920	ND-0.0815	0.0133-71.1	0.00090-0.159	ND-0.0533	0.00453-0.695	0.00119-0.0422	0.00342-0.162	ND-0.0696	ND-0.114
	Average value	0.00192	0.215	0.0377	0.563	0.0165	0.00376	0.0105	2.06	0.0243	0.00700	0.0833	0.00955	0.0399	0.0192	0.0244
	detection limit	0.00162	-	-	0.00177	0.0007	0.00192	0.00253	-	-	0.00017	-	-	-	0.00310	0.00517
Chunghua area（2017）	Concentration range	ND-0.625	ND-1.75	ND-0.257	・p, p'- DDT：ND- 16.3 ・ o, p'- DDTND - 2.48	ND-1.40	ND-1.08	ND-0.880	0.012-1.25	ND-3.51	ND-0.210	0.001-0.142	ND-0.396	ND-1.05	ND-0.145	ND-0.279
	Average value	0.100	0.092	0.026	・p, p'-：1.74 ・o, p'-：0.0370	0.102	0.117	0.187	0.189	0.224	0.025	0.045	0.045	0.133	0.040	0.065
	detection limit	0.0024	0.0012	0.0005	・p, p'-：0.0053 ・o, p'-：0.0039	0.0048	0.0026	0.0009	-	0.0006	0.0037	-	0.0029	0.0045	0.0053	0.0083

Unit：μg/kg dry weight

Note：In 2015 45 river monitoring points in Jianan area included Sandie Creek, Puzi Creek, Bazhang Creek, Touqian Creek, Baishui Creek, Liuzhong Creek, Saltwater Creek and Erren Creek. In 2017, 30 river monitoring points in Chunghua area included four rivers, which were Maoluo Creek, Old Zhuoshui Creek, Yangzicuo Creek drainage system and Yuliao Creek and drainage system.

Table 11 Results of organochlorine agro pesticides in wetland sediments tested by the Bureau of Environmental Inspection of EPA during 2011-2014

year / wetland / POPs	2011			2012			2013			2014		
	Tainan Sicao wetland	Zengwen Creek mouth wetland	Chigu wetland	Beigang Creek Koaogu wetland	Puzi Creek mouth wetland	Bazhang Creek mouth Haomeiliao wetland	Langyang Creek mouth wetland	Wuwei Port wetland	Hualian Creek mouth wetland	Sizhong Creek mouth wetland	Beinan Creek mouth wetland	Taiping Creek mouth wetland
Hexachlorobenzene	0.721-11.9 (4.59)	0.574-7.83 (3.19)	ND - 7.67 (4.66)	ND- 0.348 (0.071)	ND-0.067 (0.019)	ND-0.497 (0.076)	ND-0.108 (0.027)	ND- 0.281 (0.035)	ND	ND- 0.205 (0.060)	ND- 0.204 (0.025)	ND- 0.495 (0.072)
Heptachlor				ND- 0.398 (0.127)	ND-0.382 (0.220)	ND-1.12 (0.244)	ND-0.296 (0.030)	ND-0.057 (0.005)	ND	ND	ND	ND
Aldrin				ND- 0.297 (0.140)	ND-0.335 (0.142)	ND-0.839 (0.184)	ND-0.480 (0.149)	ND-0.435 (0.167)	ND-0.435 (0.101)	ND- 0.667 (0.336)	ND- 0.563 (0.077)	ND- 0.632 (0.053)
Chlordane				0.024-0.268 (0.152)	ND-0.246 (0.121)	ND-0.223 (0.109)	ND-0.480 (0.080)	ND-0.418 (0.104)	ND-0.418 (0.087)	ND- 0.455 (0.067)	ND- 0.396 (0.033)	ND- 0.727 (0.116)
Dieldrin				ND- 0.222 (0.084)	ND-0.182 (0.074)	ND-1.07 (0.157)	ND-0.366 (0.117)	ND-0.315 (0.054)	ND-0.030 (0.002)	ND- 0.352 (0.029)	ND	ND
Endrin				ND- 0.283 (0.072)	ND-0.089 (0.014)	ND-1.35 (0.176)	ND-0.206 (0.042)	ND-0.899 (0.105)	ND-0.254 (0.053)	ND	ND- 1.382 (0.184)	ND
DDT				0.566-0.759 (0.655)	ND-0.739 (0.566)	0.534-1.97 (0.735)	ND-0.678 (0.258)	ND-5.339 (0.776)	ND-0.607 (0.220)	ND- 1.296 (0.481)	ND- 2.166 (0.573)	ND- 1.183 (0.174)
Toxaphene				ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	-	-	-	ND-0.374 (0.290)	ND -0.352 (0.167)	ND–1.07 (0.252)	ND-0.418 (0.111)	ND	ND-0.031 (0.003)	ND	ND	ND
α-Endosulfan	-	-	-	ND - 0.109 (0.043)	ND -0.079 (0.034)	ND-0.504 (0.070)	ND-0.557 (0.153)	ND-0.474 (0.166)	ND-0.474 (0.169)	ND	ND	ND
β-Endosulfan	-	-	-	ND - 0.132 (0.057)	ND -0.109 (0.037)	ND-0.092 (0.037)	ND-0.519 (0.184)	ND-1.228 (0.212)	ND-0.362 (0.079)	ND	ND	ND
Overall	ND - 11.9 (3.19 - 4.76)			ND - 1.97(ND- 0.735)			ND-5.339(ND-0.776)			ND-2.166(ND-0.573)		

Note1：unit μg/kg dry weight.

Note2：In 2012 and in 2013, the detection limits were hexachlorobenzene 0.099 μg/kg, Heptachlor 0.022 μg/kg, Aldrin 0.015 μg/kg, Chlordane0.032 μg/kg, Dieldrin 0.030μg/kg, Endrin 0.066 μg/kg, DDT0.080 μg/kg, Toxaphene2.28 μg/kg, Lindane0.024μg/kg, α- Endosulfan 0.024μg/kg, β- Endosulfan 0.042 μg/kg. In 2014, the detection limits were hexachlorobenzene 0.063 μg/kg, Heptachlor 0.017 μg/kg, Aldrin 0.014 μg/kg, Chlordane 0.013 μg/kg, Dieldrin 0.018μg/kg, Endrin 0.060 μg/kg, DDT0.019 μg/kg, Toxaphene1.193 μg/kg, Lindane0.011μg/kg, α- Endosulfan 0.011μg/kg, and β- Endosulfan 0.018 μg/kg.

Note3：test concentration range（average value）

Table 12 Results of organochlorine agro pesticides in wetland organism tested by the Bureau of Environmental Inspection of EPA during 2011-2014

Year/ Wetland/ POPs	2011			2012			2013			2014		
	Tainan Sicao wetland	Zengwen Creek mouth wetland	Chigu wetland	Beigang Creek Koaogu wetland	Puzi Creek mouth wetland	Bazhang Creek mouth Haomeiliao wetland	Langyang Creek mouth wetland	Wuwei Port wetland	Hualian Creek mouth wetland	Sizhong Creek mouth wetland	Beinan Creek mouth wetland	Taiping Creek mouth wetland
Hexachlorobenzene	3.02-49.7 (13.7)	1.40 - 9.56 (6.27)	6.24 - 12.7 (10.0)	ND	ND-0.058 (0.004)	ND-0.074 (0.005)	ND-0.929 (0.184)	ND-7.37 (1.508)	ND	ND-0.673 (0.056)	ND-0.688 (0.057)	ND-0.982 (0.187)
Heptachlor				ND - 2.62 (0.409)	ND - 1.34 (0.473)	ND- 1.66 (0.450)	ND	ND-0.407 (0.034)	ND	ND-0.918 (0.077)	ND	ND
Aldrin				ND-0.753 (0.296)	ND-0.534 (0.220)	ND-0.570 (0.205)	ND-1.434 (0.284)	ND-1.092 (0.282)	ND-0.895 (0.075)	ND	ND	ND-1.204 (0.100)
Chlordane				ND-0.807 (0.198)	ND-0.555 (0.209)	ND 0.590 (0.225)	ND-1.267 (0.534)	ND-0.746 (0.062)	ND-1.804 (0.205)	ND-1.416 (0.912)	1.033-1.442 (1.211)	ND-1.801 (0.897)
Dieldrin				ND-0.684 (0.185)	ND-0.455 (0.192)	ND-0.611 (0.223)	ND-2.349 (1.031)	ND-1.623 (0.683)	ND-7.270 (1.731)	ND-1.744 (0.921)	ND-2.240 (1.191)	ND-3.276 (1.086)
Endrin				ND-0.319 (0.151)	ND - 0.307 (0.062)	ND-0.235 (0.100)	ND-0.755 (0.232)	ND-1.129 (0.155)	ND-0.890 (0.074)	ND	ND-1.065 (0.089)	ND
DDT				ND - 6.02 (1.64)	ND - 9.68 (2.36)	0.479 -3.89 (1.44)	ND-1.241 (0.353)	ND-1.328 (0.262)	ND-0.866 (0.766)	ND-1.610 (0.134)	ND	ND-2.045 (0.170)
oxaphene				ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	-	-	-	0.381-1.45 (0.679)	ND - 1.11 (0.449)	ND–1.28 (0.630)	ND-1.159 (0.326)	ND	ND-1.204 (0.293)	ND	ND	ND-1.340 (0.426)
α-Endosulfan	-	-	-	ND - 0.501 (0.108)	ND - 0.271 (0.099)	ND-0.276 (0.079)	ND	ND	ND	ND	ND	ND
β-Endosulfan	-	-	-	ND - 0.017 (0.001)	ND-1.44 (0.146)	ND-2.06 (0.152)	ND-0.569 (0.047)	ND-0.747 (0.113)	ND-1.192 (0.161)	ND	ND	ND
Overall	1.40 - 49.7 (6.27 - 13.7)			ND-9.68 (ND- 2.36)			ND-7.37 (ND-1.731)			ND-3.276 (ND-1.211)		

Note1：unit μg/kg wet weight.

Note2：In 2012 and in 2013, the detection limits were hexachlorobenzene 0.99μg/kg, Heptachlor 0.22μg/kg, Aldrin 0.15μg/kg, Chlordane 0.32μg/kg, Dieldrin 0.30μg/kg, Endrin 0.66μg/kg, DDT 0.80μg/kg, Toxaphene 22.8μg/kg, Lindane 0.24 μg/kg, α- Endosulfan 0.24μg/kg, and β- Endosulfan 0.42μg/kg. In 2014, the detection limits were hexachlorobenzene 0.63μg/kg, Heptachlor 0.17μg/kg, Aldrin 0.14μg/kg, Chlordane0.13μg/kg, Dieldrin0.18μg/kg, Endrin 0.60μg/kg, DDT 0.19μg/kg, Toxaphene 11.93μg/kg, Lindane 0.11 μg/kg, α- Endosulfan 0.11μg/kg, and β- Endosulfan 0.18μg/kg.

Note3：Test concentration range（average value）

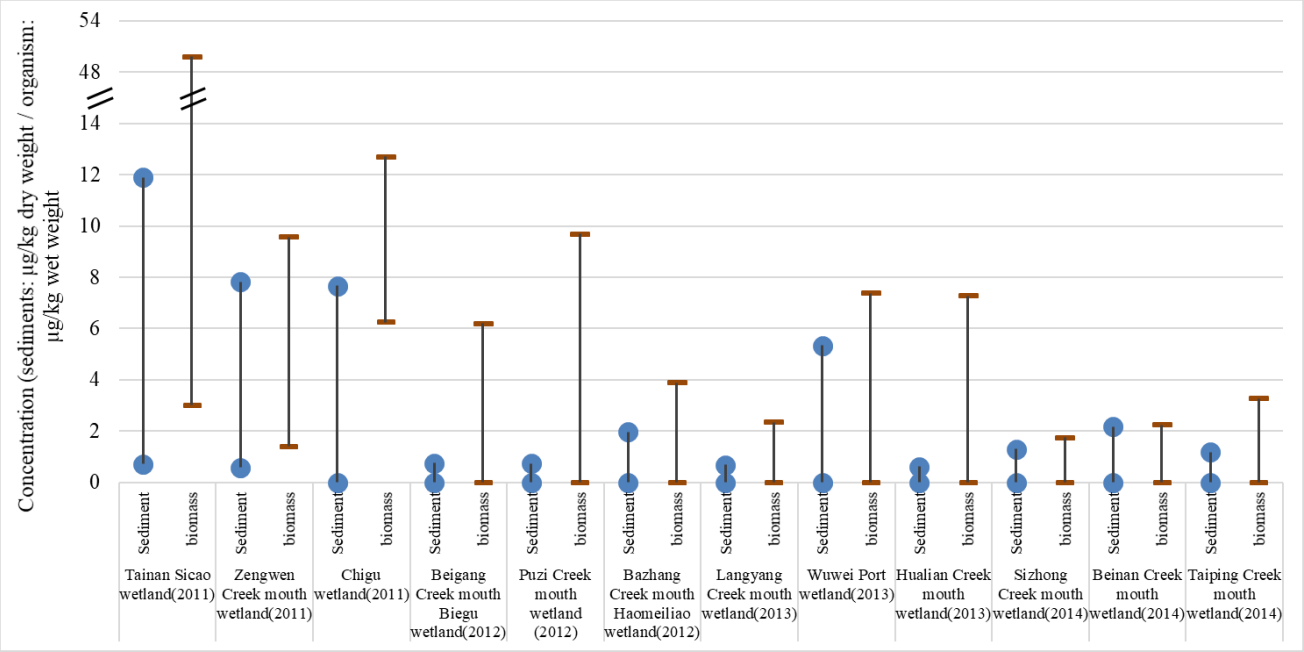


Figure 2　Distribution of contents of organochlorine agro pesticides in wetland sediments and organism tested by the Bureau of Environmental Inspection of EPA during 2011-2014

Table 13　Investigation results of residual agro pesticides in sediments from irrigation ditches in special rice cultivation area（2004 samples）

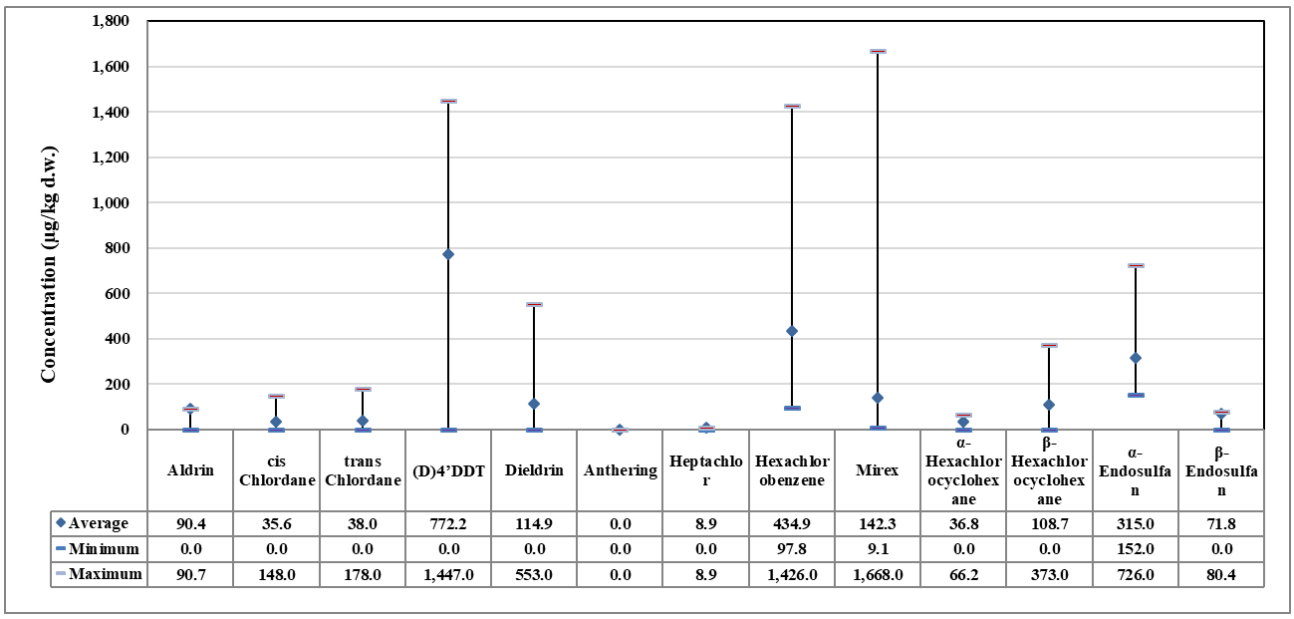
OCPs	Positive sample (%)	Average (μg/kg dry wt.)	Range (μg/kg dry wt.)
Aldrin	18.1	0.84	ND [2]– 7.50
BHC	6.25	0.23	ND – 10.3
DDE	9.03	1.00	ND – 70.0
DDD	0.69	0.03	ND – 4.52
DDT	4.86	1.31	ND - 120
Endrin	2.78	0.76	ND – 46.8
Heptachlor	1.39	0.23	ND – 29.9
Heptachlor epoxide	2.08	0.14	ND – 10.4
Dieldrin	0	ND[3]	ND

1)Data from: initial

2) 144 samples

3) ND = Non-detectable

Data source：From the contents of「Investigation and safety assessment of organochlorine agro pesticides residues in agricultural environment」presented by Agricultural Chemicals and Toxic Substances Research Institute of COA in「Forum on Achievements Review and Future Prospects after 10 Years of Investigation of Environmental Distribution of Toxic Chemicals」in 2009 .



	Aldrin	cis Chlordane	trans Chlordane	(D)4'DDT	Dieldrin	Anthering	Heptachlor	Hexachlorobenzene	Mirex	α-Hexachlorocyclohexane	β-Hexachlorocyclohexane	α-Endosulfan	β-Endosulfan
Average	90.4	35.6	38.0	772.2	114.9	0.0	8.9	434.9	142.3	36.8	108.7	315.0	71.8
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.8	9.1	0.0	0.0	152.0	0.0
Maximum	90.7	148.0	178.0	1,447.0	553.0	0.0	8.9	1,426.0	1,668.0	66.2	373.0	726.0	80.4

Note：If organochlorine agro pesticide is not detected (lower than the minimum detection limit, MinDL), the result is expressed by 0.

Figure 3　Distribution of concentration of organochlorine agro pesticides in river and ditch sediments in 2019

D. Environmental Soils

(A) General environmental soils

From 2016 to 2017, Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of distribution of agro pesticides（including Endrin, Aldrin , Toxaphene, Heptachlor, Chlordane, Dieldrin, DDT） in the rice cultivation areas of Chunghua and Yunlin, and the detected concentrations of solid DDT and DDE were 1~4 μg/kg and 1~3μg/kg, respectively, lower than the soil pollution control standards；and in 2017 conducted the investigation of residual concentration of agro pesticides POPs and their derivatives in domestic solid (140 samples), and the result of average value was ranked from high to low like p, p'- DDE（average 0.0036 mg/kg）, p, p'- DDT（average 0.00221 mg/kg）, hexachlorobenzene（average 0.00143 mg/kg）, and the concentrations for all agro pesticides were below the soil pollution control standards. For detection rate, except total DDT above 73%, the detection rates for the other agro pesticides were all below 15%, and in a further analysis, the residual DDT in soils was mainly DDE, which was thought as historical residue. For detailed results, see Table 14

Table 14 Statistics of investigation and detection rate for residual agro pesticides in environmental soils

agro pesticides（including derivatives）	Detection rate (%)	concentration value (mg/kg)	Average value (mg/kg)		Organochlorine ratio in agro pesticides (%)
			Negligible ND	non-negligible ND (ND=0.0004)	
hexachlorobenzene	15.0	ND~0.123	0.00725(n=21)	0.00143	13.3
Heptachlor	0	ND	—	0.00040	0
Epoxy Heptachlor	0	ND	—	0.00040	0
Aldrin	3.6	ND~0.0268	0.00658(n=5)	0.00063	3.0
Endrin	0.7	0.00043	0.00043(n=1)	0.00041	0
Dieldrin	1.4	ND~0.00158	0.00002(n=2)	0.000402	0.2
α-Chlordane	0.7	0.00078	0.00078(n=1)	0.000403	0.1
γ-Chlordane	0.7	0.00043	0.00043(n=1)	0.0004002	0.037
o, p'- DDE	6	ND~0.00477	0.00231(n=8)	0.00051	1.6
p, p'- DDE	55	ND~0.205	0.00621(n=77)	0.00360	41.8
o, p'- DDD	8	ND~0.00532	0.00138(n=11)	0.00048	1.3
p, p'- DDD	17	ND~0.0347	0.00325(n=24)	0.00089	6.8
o, p'- DDT	16	ND~0.0135	0.00214(n=23)	0.00069	4.3
p, p'- DDT	52	ND~0.104	0.00387(n=73)	0.00221	24.6
Mirex	1.4	ND~0.00093	0.00068(n=2)	0.000404	0.1
Toxaphene	0	ND	—	—	0
pentachlorobenzene	9.3	ND~0.001	0.0006(n=13)	0.000420	0.7
α-Hexachlorocyclohexane (α-BHC)	1.4	ND~0.00486	0.00291(n=2)	0.00044	0.5
β-Hexachlorocyclohexane (β-BHC)	1.4	ND~0.00343	0.00235(n=2)	0.00043	0.4
Lindane	0.7	ND~0.00304	0.00304(n=1)	0.00042	0.3
chlordecone	0	ND	—	—	0
Endosulfan-a	3	ND~0.00312	0.0016(n=4)	0.00043	0.6
Endosulfan-b	3	ND~0.00193	0.0011(n=4)	0.00042	0.4

Note： number of soil sample (n) 140

(B) Farmland Soil

Since 1973, Agricultural Chemicals and Toxic Substances Research Institute of COA has conducted investigation of residual persistent organochlorine agro pesticides in the farmland in Taiwan about every 10 years（5 times so far）, and Table 15 has the details. It is known that there is a gradual decreasing trend of residual organochlorine agro pesticides in soils. In 2012, the test of residual Endosulfan in 30 soil samples from the Cruciferous vegetable field in Chunghua and Yunlin area, and the result indicated the residual Endosulfan in soil was all below 1 ppb. The result in 2014（Table 16）shows that the average concentration of residual organochlorine agro pesticides was all below 0.5 μg/kg, and the detected organochlorine agro pesticides of the first group rank in percentage from high to low as DDT (11.0%) > Chlordane (1.0%) > Aldrin (0.5%).

In 2017, Agricultural Chemicals and Toxic Substances Research Institute of COA continued to sample the soils from 100 places of farmland in Taiwan and investigate the residual persistent organochlorine agro pesticides in farmland in Taiwan. The result shows that the soil samples from 41 of 100 places were detected for residual organochlorine agro pesticides like DDT, DDE and DDD, and the total (DDT+DDE+DDD) of residual DDT in farmland was 0.001-0.054 mg/kg, far lower than the Canadian farmland soil standard 0.7 mg/kg, and the residual organochlorine agro pesticides in other 59 soil samples were lower than the quantitation limit（quantitation limit：Dieldrin, Aldrin 2.00μg/kg, other agents 1.00μg/kg）.

E. Environmental water body

During 2011-2012, Department of Environmental Monitoring and Information Management of EPA focus on 40 river monitoring points, 8 reservoirs (8 test stations）, 15 marine test stations；in 2015, 7 river monitoring points, 5 reservoir test stations, and 10 marine test stations; in 2016, 8 river monitoring points, 5 reservoir test stations；in 2018, 10 river monitoring points, 15 reservoir test stations；in 2019, 10 river monitoring points, 2 reservoir test stations , and investigated the organochlorine agro pesticides（Endrin, Heptachlor, DDT, Aldrin, Dieldrin, Toxaphene, Lindane, and Endosulfan）in water, and the test results were all ND and all met the relevant domestic standard values.（detection limits for Endrin, Heptachlor, DDT, Aldrin, Dieldrin, Toxaphene, Lindane, and Endosulfan were 0.00001, 0.00002, 0.00003, 0.00001, 0.00001, 0.0002, 0.00003, 0.00018 mg/L, respectively）.

F. Drinking water

In 2019, Department of Environmental Sanitization and Toxic Substance Management of EPA focused on domestic tap water supply systems and conducted testing of 34 samples of Lindane and Endosulfan in drinking water（now by Department of Water Quality Protection）, including 31 times of testing for tap water quality and 3 simple tests for tap water quality, and the results all met the drinking water quality standard. During 2008-2019, EPA focused on domestic tap water supply systems conducted 653 times of testing of Lindane and Endosulfan in drinking water quality, including 630 times for tap water quality and 23

times for simple tap water quality, and the results all met the drinking water quality（Lindane0.0002 mg/L, Endosulfan0.003mg/L）.

Table 15 Monitoring results by COA for residual agro pesticides in farmland soils every 10 years in Taiwan COA

organochlorine agro pesticides	Average residue content (μg/ kg)									
	topsoil (0-15 cm depth)					deep soil (15-30 cm depth)				
	1973	1981	1994	2004	2014	1973	1981	1994	2004	2014
Aldrin	11.3	0.5	1.88	0.39	0.003	1.6	0.8	0.80	0.18	ND
Dieldrin	17.8	0.5	0.30	0.14	ND	11.7	1.7	0.33	0.19	ND
DDE	20.3	14.9	5.82	2.32	0.13	7.4	5.3	3.54	2.50	0.19
DDT	17.1	2.8	ND	0.08	0.23	2.2	1.5	0.06	0.14	0.31
Endrin	—	ND	0.12	0.16	ND	—	Trace	0.02	0.07	ND
Heptachlor	1.2	ND	0.10	0.02	ND	0.5	0.1	0.17	0.003	ND
Heptachlor derivatives	2.1	0.5	0.12	0.01	ND	2.1	0.8	0.01	0.03	ND
Lindane	11.8	0.7	1.11	0.07	ND	4.7	3.1	0.43	0.09	ND

Data source：「Inspection and control of persistent organic pollutants and mercury in agricultural, fishery and livestock products」published in「2015 persistent organic pollutants and mercury management conference」-Agricultural Chemicals and Toxic Substances Research Institute of COA.

Table 16 Monitoring results of residual agro pesticides in farmland by COA in Taiwan in 2014

organochlorine agro pesticides	Detection rate (%)	Range (μg/kg)
Aldrin	0.5	<0.09-0.28
Chlordane	1.0	<0.59-5.13
DDT(DDT)	11.0	<0.21-6.24
DDT metabolite DDE	13.5	<0.12-3.20
DDT metabolite DDD	4.0	<0.09-2.93
Dieldrin	0	<0.08
Endrin	0	<0.12
Heptachlor	0	<0.22
Mirex	0	<0.06
Lindane	0	<0.24
α- hexachlorocyclohexane, β-hexachlorocyclohexane	0	<0.08, <0.09
α- Endosulfan, β- Endosulfan, Endosulfansulfate	0	<0.35μg/kg, <0.07μg/kg, <0.69μg/kg

Note: 200 samples of farmland soils

G. Groundwater

From 2016 to 2017, the Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of agro pesticides（including Endrin, Aldrin, Toxaphene, Heptachlor, Chlordane, Dieldrin, DDT）in groundwater in rice cultivation area in Chunghua and Yunlin and Dieldrin (ND~0.0163 μg/L) was below domestic control

standard.

(II). Industrial chemical substances

The industrial chemical substances POPs controlled by the Convention include polybrominated diphenyl ether, hexabromobiphenyl, hexabromocyclododecane perfluorooctane sulfonic acid, polychlorinated biphenyl, pentachlorophenol, hexachlorobutadiene, short-chain chlorinated paraffin, chlorinated naphthalene . The related monitoring results for environmental media are described as follows：

A.Brominated flame retardant

(A). Polybrominated diphenyl ether

a. River sediment and fish body

In 2019, Toxic and Chemical Substances Bureau of EPA 2019 focused on 15 rivers and conducted investigation of environmental distribution for 25 kinds of PBDEs of persistent organic pollutants（ including tetrabromodiphenyl ether (BDE-47), hexabromodiphenyl ether (BDE-154, BDE-153), heptabromodiphenyl ether (BDE-175, BDE-183), and decabromodiphenyl ether (BDE-209). The result shows the average concentration and range of PBDEs in all samples of sediments is 17, 943（281-401, 946）ng/kg dry weight. The detailed result is shown in Figure 4 The average concentration and range of PBDEs in fish bodies is 502 (48.3-2, 359) ng/kg wet weight.

Regarding domestic investigation of polybrominated diphenyl ether in rivers, since 2004 EPA has completed the investigation of 30 rivers, and the average value of PBDEs in river sediments was 0.170-402μg/kg dry weight. The result is shown in Figure 5 In the most recent investigation of 30 domestic rivers (2018-2019), the main stream of Dahan River and Danshui River had the highest total PBDEs in sediments, with average concentration over 100 μg/kg dry weight；Erren Creek, Keelung River and Nankan River were the second highest, with average concentration over 60 μg/kg dry weight；and the average concentration in other rivers in dry season was below 40 μg/kg dry weight（Figure 6）.

In addition, from 2015 to 2017, the Bureau of Environmental Inspection of EPA conducted investigation of polybrominated diphenyl ether in river sediments from Jiananarea and Chunghua area, and the result is shown in Figure 7 The concentration range of tetrabromodiphenyl ether and pentabromodiphenyl ether in sediments was 0.012-4.31μg/kg dry weight；the concentration range of hexabromodiphenyl ether and heptabromodiphenyl ether was 0.00468-11.1 μg/kg dry weight.

Besides, from 2014 to 2015, the Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of sediments from 5 locations in Danshui River estuary, and the result of tetrabromodiphenyl ether in sediments was ND (detection limit 0.081) ~1.45μg/kg, and the result of pentabromodiphenyl ether was ND（detection limit 0.072）~1.11 μg/kg, and the result of hexabromodiphenyl ether was ND （detection limit 0.134 ） ~ 0.382μg/kg, and the result of heptabromodiphenyl ether was ND（detection limit 0.089）~0.303 μg/kg, and the result of decabromodiphenyl ether was 19.5~1, 340 μg/kg ；and also conducted investigation of sediments from 4 locations in Kaya Creek, and the result of decabromodiphenyl ether was ND（detection limit 1.0）~24.8μg/kg.

b. River water body

From 2014 to 2015, the Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of surface water in Danshui River estuary, and the maximum value of decabromodiphenyl ether was 1.0 mg/L.

c.Wetland sediments and organism

During 2011-2014, the Bureau of Environmental Inspection of EPA conducted testing of tetrabromo- heptabromodiphenyl ether in wetland sediments and organism, and the concentration range in sediments was ND-54.5 ng/g dry weight, and the concentration range in organism was 0.002-5.55 ng/g wet weight. The result is shown in Figure 8

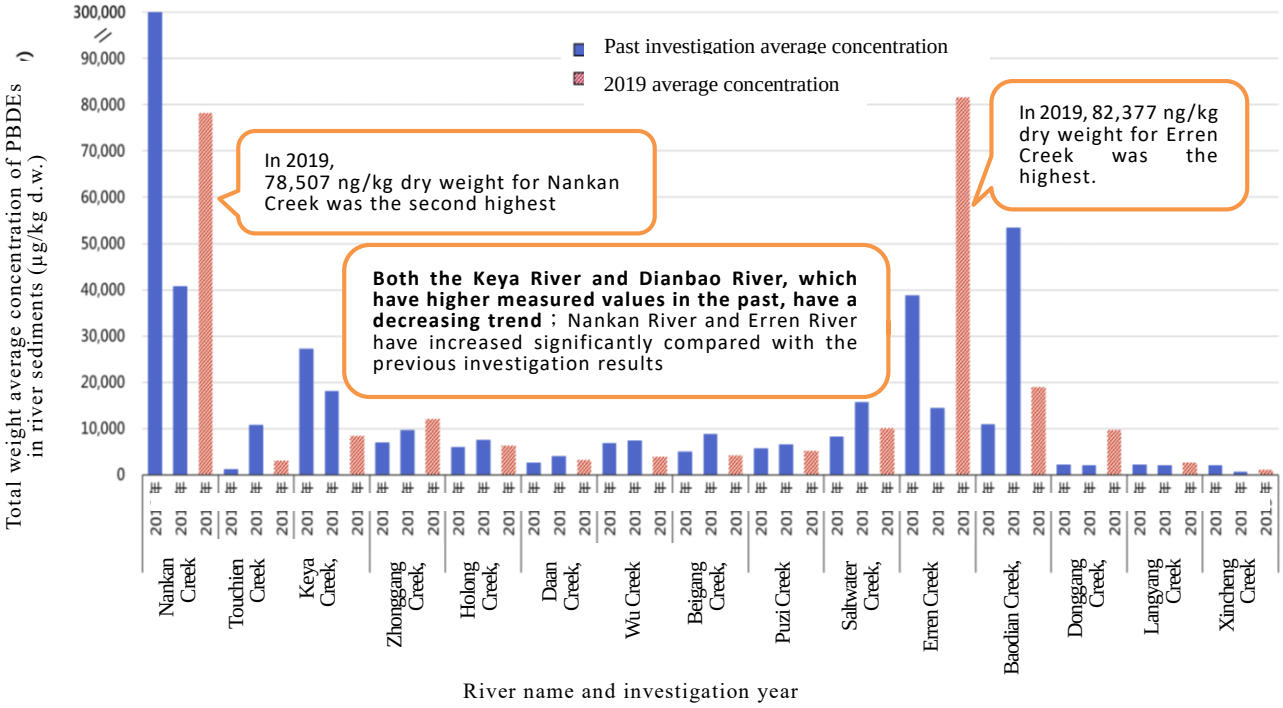
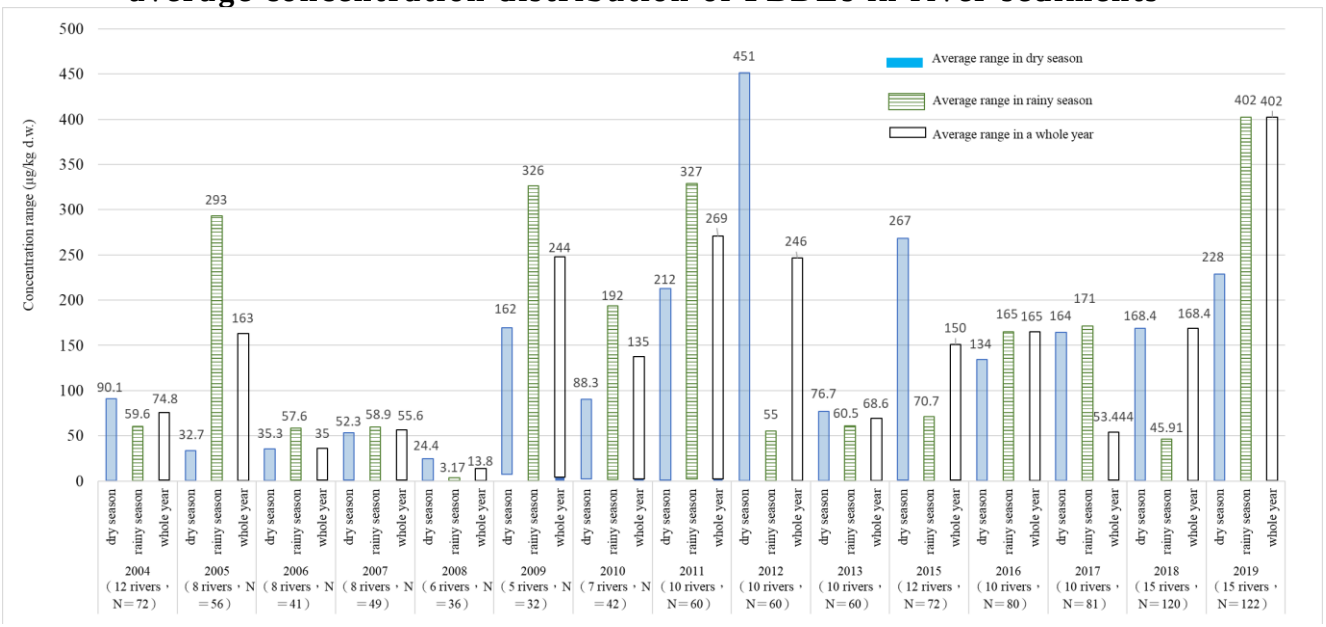


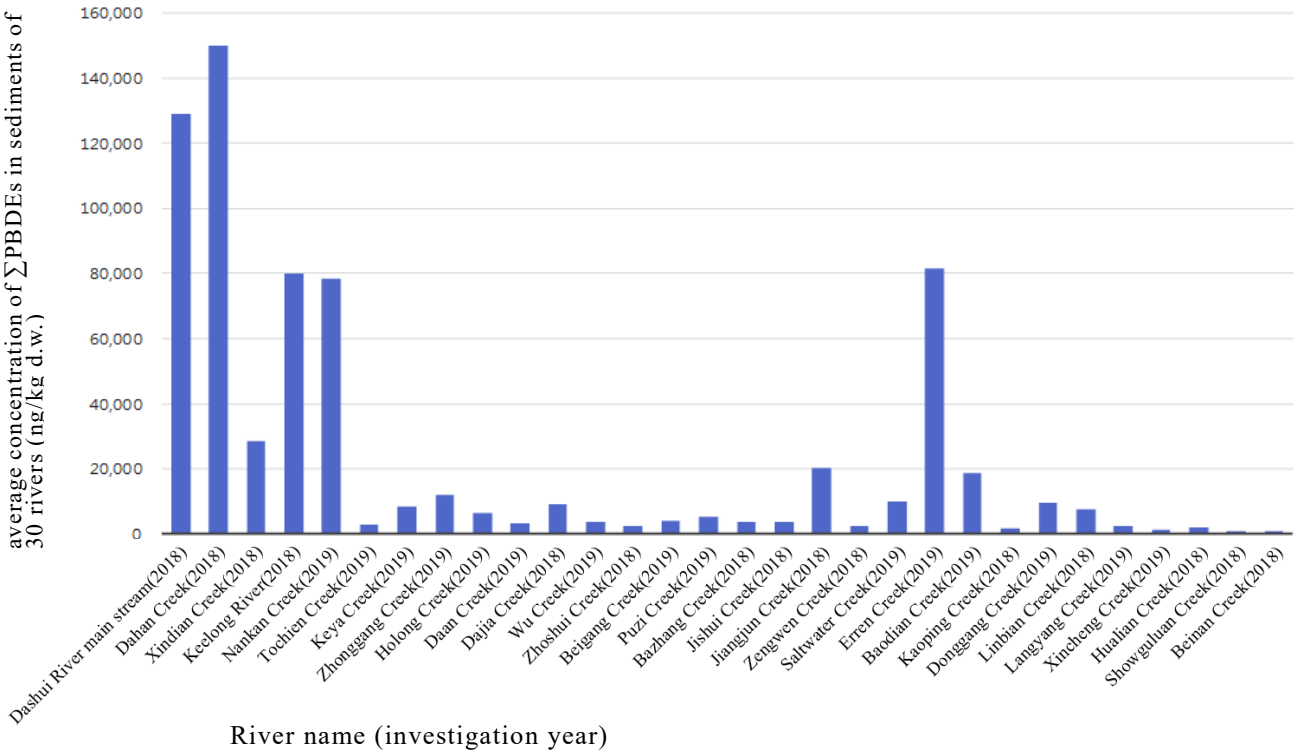
Figure 4　Comparison between 2019 and previous years in total weight average concentration distribution of PBDEs in river sediments



year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Dry season	0.609 ~ 90.1	0.545 ~ 32.7	0.163 ~ 35.3	0.784 ~ 52.3	0.263 ~ 24.4	7.37 ~ 162	1.98 ~ 88.3	0.908 ~ 212	0.579 ~ 451	0.432 ~ 76.7	1.03 ~ 267	0.312 ~ 134	0.217 ~ 164	0.170 ~ 168	0.504 ~ 228	0.504 ~ 228
Rainy season	0.536 ~ 59.6	0.151 ~ 293	0.825 ~ 57.6	0.574 ~ 58.9	0.197 ~ 3.17	0.574 ~ 326	1.52 ~ 192	2.13 ~ 327	0.357 ~ 55.0	0.279 ~ 60.5	0.611 ~ 70.7	0.175 ~ 165	0.175 ~ 171	0.264 ~ 45.9	0.281 ~ 402	0.281 ~ 402
Whole year	0.828 ~ 74.8	0.353 ~ 163	0.825 ~ 35.0	0.765 ~ 55.6	0.230 ~ 13.8	3.97 ~ 244	2.28 ~ 135	2.03 ~ 269	0.671 ~ 246	0.355 ~ 68.6	0.932 ~ 150	0.175 ~ 165	0.175 ~ 171	0.170 ~ 168	0.281 ~ 402	0.281 ~ 402

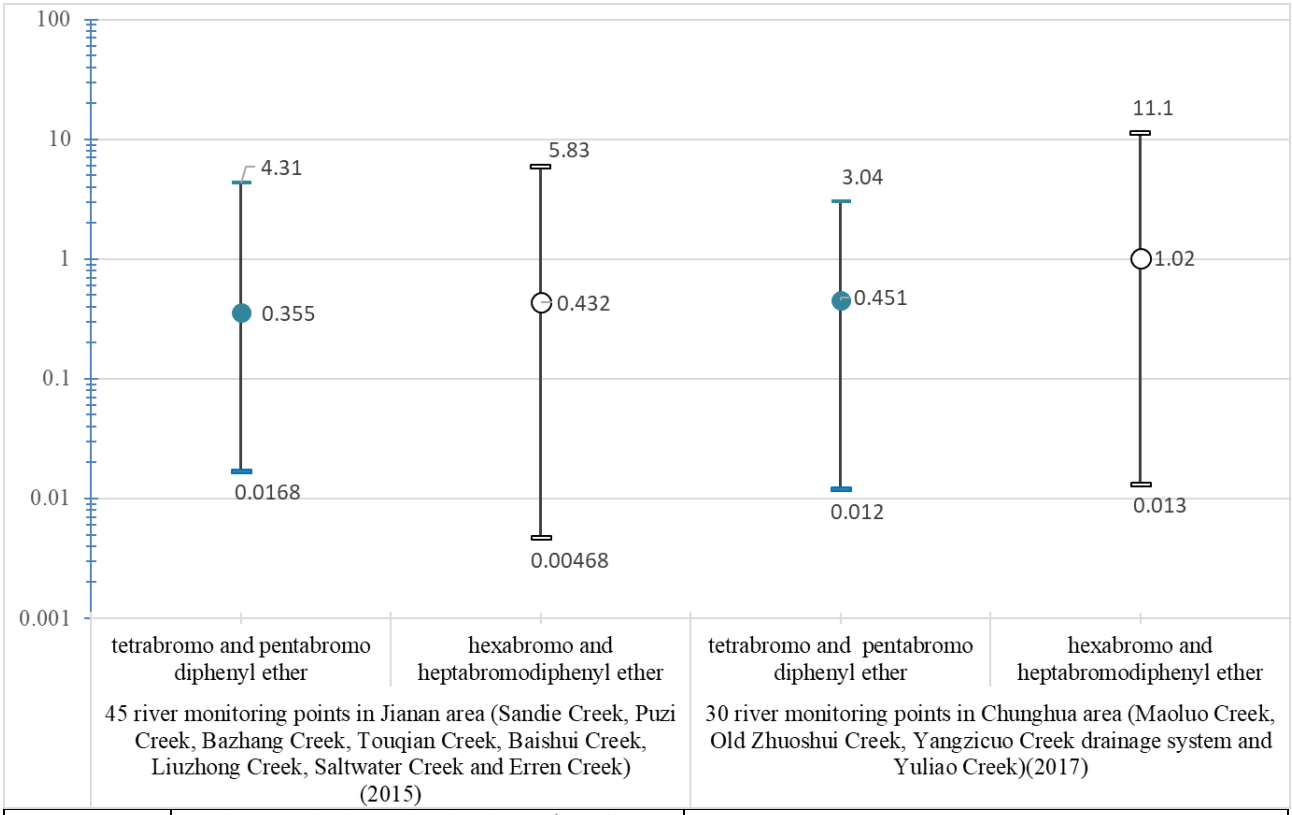
Data source： Results of Investigation of Environmental Distribution of Toxic Chemical Substances by Department of Environmental Sanitization and Toxic Substance Management of EPA（now Toxic and Chemical Substances Bureau）

Figure 5　Results of average concentration of PBDEs in river sediment over the years



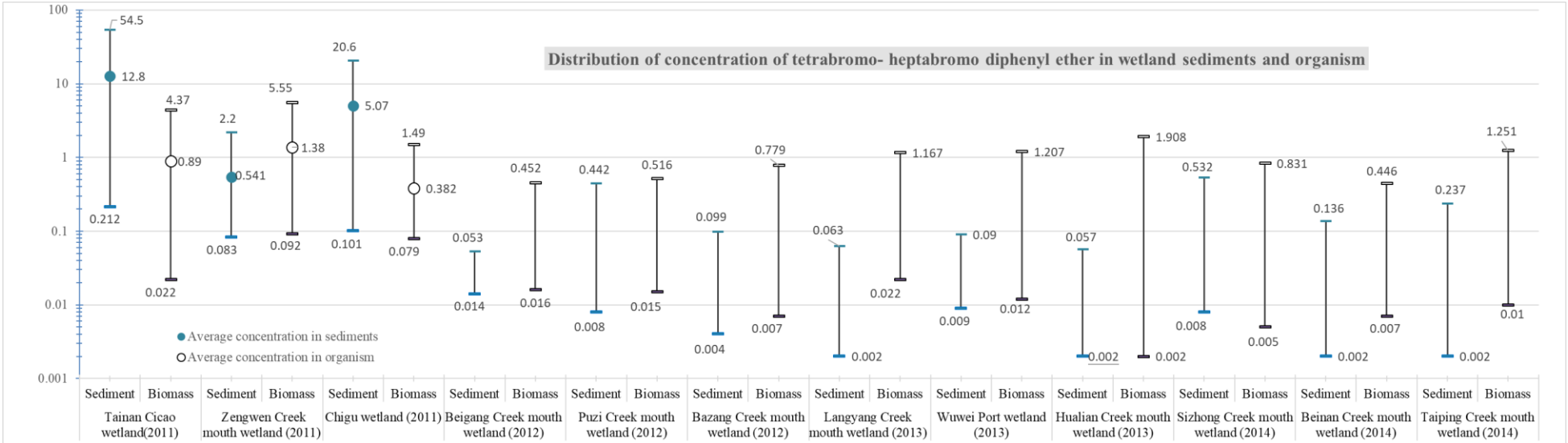
Data source：2019 Background investigation of environmental distribution of chemical substances and release management strategy plan by the Toxic and Chemical Substances Bureau of EPA

Figure 6　Distribution of total weight average concentration of PBDEs in sediments of 30 domestic rivers from the most recent investigation



Concentration distribution	45 river monitoring points in Jianan（Sandie Creek, Puzi Creek, Bazhang Creek, Touqian Creek, Baishui Creek, Liuzhong Creek, Saltwater Creek and Erren Creek）（2015）		30 river monitoring points in Chunghua area (Maoluo Creek, Old Zhuoshui Creek, Yangzicuo Creek drainage system and Yuliao Creek)（2017）	
	tetrabromo and pentabromo diphenyl ether	hexabromo and heptabromodiphenyl ether	tetrabromo and pentabromodiphenyl ether	hexabromo and heptabromodiphenyl ether
Minimum value	0.0168	0.00468	0.012	0.013
Maximum value	4.31	5.83	3.04	11.1
Average value	0.355	0.432	0.451	1.02

Figure 7 Test results of tetrabromo- heptabromo diphenyl ether in domestic river sediments



POPs \ year / wetland		2011			2012			2013			2014		
		Tainan Sicao	Zengwen Creek ◻	Chigu	Beigang Creek Koaogu	Puzi Creek mouth	Bazhang Creek mouth Haomeiliao	Langyang Creek mouth	Wuwei Port	Hualian Creek mouth	Sizhong Creek mouth	Beinan Creek mouth	Taiping Creek mouth
sediments	tetrabromo - pentabromodiphenyl ether	0.212 -54.5 (12.8)	0.083 - 2.20 (0.541)	0.101 - 20.6 (5.07)	0.014-0.046 (0.030)	0.014-0.126 (0.064)	0.013-0.077 (0.031)	0.008-0.063 (0.021)	0.009-0.090 (0.041)	0.004-0.057 (0.018)	0.017 - 0.532 (0.076)	0.008 - 0.136 (0.043)	0.007 - 0.237 (0.068)
	hexabromo - heptabromodiphenyl ether				0.016-0.053 (0.034)	0.008-0.442 (0.100)	0.004-0.099 (0.016)	0.002-0.041 (0.011)	0.009-0.062 (0.024)	ND-0.017 (0.006)	0.008 - 0.307 (0.057)	0.002 - 0.018 (0.008)	0.002 - 0.113 (0.032)
	Overall	0.083-54.5 (0.541 - 12.8)			0.004-0.442(0.016-0.100)			ND-0.090(0.006-0.041)			0.002-0.532(0.008-0.076)		
organism	tetrabromo - pentabromodiphenyl ether	0.022 - 4.37 (0.89)	0.092 - 5.55 (1.38)	0.079 - 1.49 (0.382)	0.019-0.452 (0.111)	0.019-0.516 (0.165)	0.012-0.779 (0.183)	0.113-1.167 (0.463)	0.061-1.207 (0.368)	0.009-1.908 (0.571)	0.029 - 0.831 (0.209)	0.022 - 0.446 (0.126)	0.017 – 1.251 (0.211)
	hexabromo - heptabromodiphenyl ether				0.016-0.191 (0.077)	0.015-0.367 (0.110)	0.007-0.346 (0.093)	0.022-0.162 (0.075)	0.012-0.120 (0.051)	0.002-0.629 (0.126)	0.005 - 0.164 (0.062)	0.007 - 0.076 (0.024)	0.010 – 0.121 (0.038)
	Overall	0.022-5.55(0.382 - 1.38)			0.007 -0.779(0.077 - 0.183)			0.002 -1.908(0.051-0.571)			0.005-1.251(0.024-0.211)		

Note：sediments unit ng/g dry weight；organism unit ng/g wet weight. Detection limit for hexabromo diphenyl ether and heptabromodiphenyl ether sediments was 0.002 ng/g. The value in（ ）is the average value.

Figure 8　Test results of tetrabromo–heptabromo diphenyl ether in domestic sediments and organism during 2011-2014

d. Irrigation ditch sediments

In 2019, the Bureau of Environmental Inspection of EPA investigated 30 river ditch monitoring points in Kaoping area, and the concentration range of hexabromodiphenyl ether and heptabromodiphenyl ether in sediments was 0.146-163（average 130.2）ng/kg d.w.；the concentration range of tetrabromodiphenyl ether and pentabromodiphenyl ether was 1.49-29, 100（average 790.6）ng/kg d.w.

e. Environmental soils

From 2014 to 2019, the Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of polybrominated diphenyl ether in environmental soils. For details, see Table 17 In 2019, the average monitoring concentration of polybrominated diphenyl ether in the soils around the potentially polluted area was 38.6μg/kg, and the average monitoring concentration of general environmental baseline content was 9.90 μg/kg.

Table 17 Investigation results of polybrominated diphenyl ether in domestic environmental soils

year	Investigation location and amount	Concentration range and average value(μg/kg)
2014-2015	Soils along Danshui River (3 points)	ND~0.116
2017	13 sites of soils around potential pollution source of polybrominated diphenyl ether（60 samples）	0.189～656（average 39.6）
	general environmental baseline content（60 samples）	0.268～41.9（average 6.25）
2019	33 sites of soils around potential pollution source of polybrominated diphenyl ether（111 samples）	0.904～511（average 38.6）
	general environmental baseline content（106 samples）	1.87～88.1（average 9.90）

f. Groundwater

From 2014 to 2015, the Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of simple well groundwater at three locations along Danshui River estuary, and found tetrabromodiphenyl ether (ND~1.16 mg/L), pentabromodiphenyl ether (ND~1.09 mg/L), hexabromodiphenyl ether (ND~0.69 mg/L), heptabromodiphenyl ether (ND~1.51 mg/L), octabromo diether (ND~0.99 mg/L), decabromodiphenyl ether (ND~356 mg/L)；and in 2015 focused investigation on emerging pollutants from specialty chemicals and pharmaceutical

biotechnology industries and conducted sampling for 11 companies and 29 groundwater sites, among which 16 sites found polybrominated diphenyl ether compounds ND. In the second stage of investigation of groundwater, it only found decabromodiphenyl ether (ND~0.0883mg/L) as polybrominated diphenyl ether （detection limit: tetrabromodiphenyl ether was 0.70 mg/L, and pentabromodiphenyl ether was 0.37 mg/L, and hexabromodiphenyl ether was 0.57 mg/L, and heptabromodiphenyl ether was 0.13 mg/L, and octabromo diether was 0.68 mg/L, and decabromodiphenyl ether was 1.34 mg/L）.

Besides, in 2015, the Bureau of Environmental Inspection of EPA tested 24 compounds of polybrominated diphenyl ether from 10 groundwater monitoring wells and the detected concentration was 14.0~226 pg/L, decabromo (BDE-209) as the largest source, on average taking up 80% polybrominated diphenyl ether. In 2016, the concentration of polybrominated diphenyl ether in groundwater from the plant ever operating with decabromodiphenyl ether was 10.2 and 167 ng/L, indicating the area still had brominated flame-retardant residue.

g. Stationary pollution source flue emission

In 2008, Department of Air Quality Protection and Noise Control of EPA focused on 4 domestic large incinerators and 1 Electric arc furnace for steelmaking industry to conduct flue emission test of polybrominated diphenyl ether （including tetrabromo - heptabromodiphenyl ether as the POPs controlled under the Convention）, showing the concentration from large incinerators was ND-0.790 ng/Nm^3； and the concentration range from arc furnace was 1.39-3.08 ng/$Nm^{(C)}$ For details, see Figure 9

Large incinerator A plant (1350 tons/day)						Large incinerator B plant (900 tons/day)				
2,4,4'-TrBDE(ng)	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.1642	0.1016	0.0636	0.0635	0.0578
2,2',4,4'-TeBDE(ng)	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.5068	0.5212	0.3910	<0.0008	<0.0008
2,2',4,4',5-PeBDE(ng)	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021
2,2',4,4',6-PeBDE(ng)	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
2,2',4,4',5,5'-HxBDE(ng)	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169
2,2',4,4',5',6-HxBDE(ng)	<0.0191	0.5829	<0.0191	<0.0191	0.6789	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191
2,2',3,4,4',5',6-HpBDE(ng)	<0.0385	2.0051	<0.0385	<0.0385	2.7906	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385
Total PBDEs (ng/Nm³)	**ND**	**0.7905**	**ND**	**ND**	**1.0675**	**0.1794**	**0.1613**	**0.1198**	**0.0167**	**0.0147**

Large incinerator C plant (900 tons/day)						Large incinerator D plant (600 tons/day				
2,4,4'-TrBDE(ng)	0.1974	0.3606	0.5477	0.2711	0.2466	0.1235	0.1433	0.1237	0.1100	0.0779
2,2',4,4'-TeBDE(ng)	0.4977	0.7071	0.9934	0.6144	1.0126	<0.0008	0.4784	0.4276	0.5466	1.3652
2,2',4,4',5-PeBDE(ng)	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021
2,2',4,4',6-PeBDE(ng)	0.5512	0.4885	0.7356	0.5724	0.5350	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
2,2',4,4',5,5'-HxBDE(ng)	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169
2,2',4,4',5',6-HxBDE(ng)	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191	<0.0191
2,2',3,4,4',5',6-HpBDE(ng)	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385	<0.0385
Total PBDEs (ng/Nm³)	**0.3067**	**0.3830**	**0.5333**	**0.3436**	**0.4319**	**0.0294**	**0.1453**	**0.1291**	**0.1503**	**0.3314**

2,4,4'-TrBDE(ng)	0.60636	0.22354	0.16808
2,2',4,4'-TeBDE(ng)	5.40356	2.35028	2.33852
2,2',4,4',5-PeBDE(ng)	1.17148	0.56918	0.57124
2,2',4,4',6-PeBDE(ng)	4.22146	2.3117	2.33946
2,2',4,4',5,5'-HxBDE(ng)	<0.0169	<0.0169	<0.0169
2,2',4,4',5',6-HxBDE(ng)	<0.0191	<0.0191	<0.0191
2,2',3,4,4',5',6-HpBDE(ng)	<0.0385	<0.0385	<0.0385
Total PBDEs (ng/Nm³)	**3.0752**	**1.4190**	**1.3876**

Arc furnace
(carbon steel plant in Taichung, 85 tons/batch)
(Data source: EPA 2008 "Emission investigation and control plan for stationary polluting source toxic air pollutants" Sinotech Engineering Consultants

Figure 9 Test results of polybrominated diphenyl ether from domestic large incinerators and arc furnaces

h. Industrial discharged water

In 2012, the Department of Water Quality Protection of EPA investigated the industries of processes operating with polybrominated diphenyl ether (chemical industry, other industries, rubber product industry), waste landfill and sewer system in industrial area for the concentration of polybrominated diphenyl ether in the discharged water, and except that hexabromodiphenyl ether (BDE-153) concentration was ND-111 ng/L, and decabromodiphenyl ether (BDE-209) concentration was ND-16, 978 ng/L, the concentrations of tetrabromodiphenyl ether (BDE-47), pentabromodiphenyl ether (BDE-99 and BDE-100), hexabromodiphenyl ether(BDE-154), and heptabromodiphenyl ether(BDE-183) were all below the detection limit.

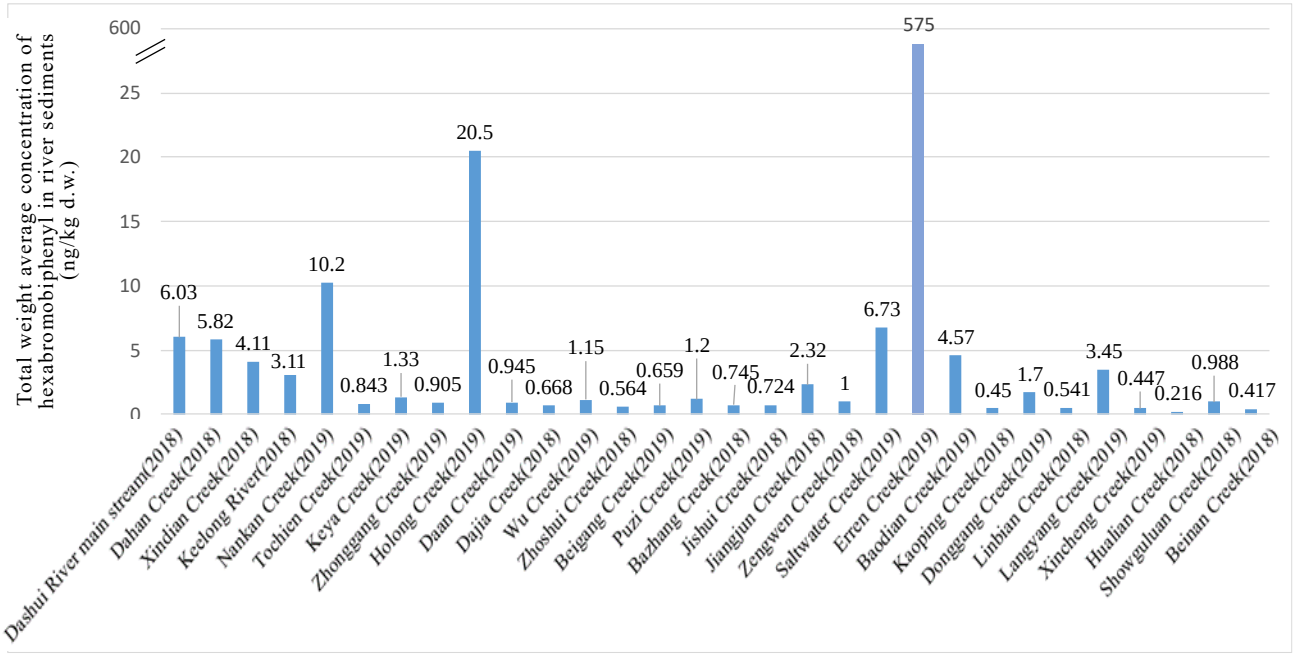
Besides, from 2014 to 2015, the Soil and Groundwater Remediation Fund Management Board of EPA focused on 2 wastewater treatment plants and 4 hospitals for 11 times of controlled original wastewater and discharged water quality investigation, and from sewage plant, hospital wastewater and discharged water, the test found 2, 2', 4, 4', 5- pentabromodiphenyl ether (ND~0.57 mg/L) and decabromodiphenyl ether (ND~7.99 mg/L).

(B) Hexabromobiphenyl

In 2019, the Toxic and Chemical Substances Bureau of EPA focused on 15 rivers to conduct the investigation of environment distribution of 5 hexabromobiphenyl substances in 122 samples of sediments, the total weight average concentration and range for hexabromobiphenyl homologue in all sediments was 41.5 (0.133-2, 184) ng/kg dry weight, and during dry season the average concentration and range in the sediments was 23.4 (0.133-876) ng/kg dry weight, and during rainy season the average concentration and range in the sediments was 59.5 (0.311-3, 493) ng/kg dry weight, and in some rivers the PBBs in the sediments during rainy season was higher than that during dry season. The average concentration 575 ng/kg dry weight for Erren Creek was the highest, and the average concentration 20.5 ng/kg dry weight for Houlong Creek was the next.

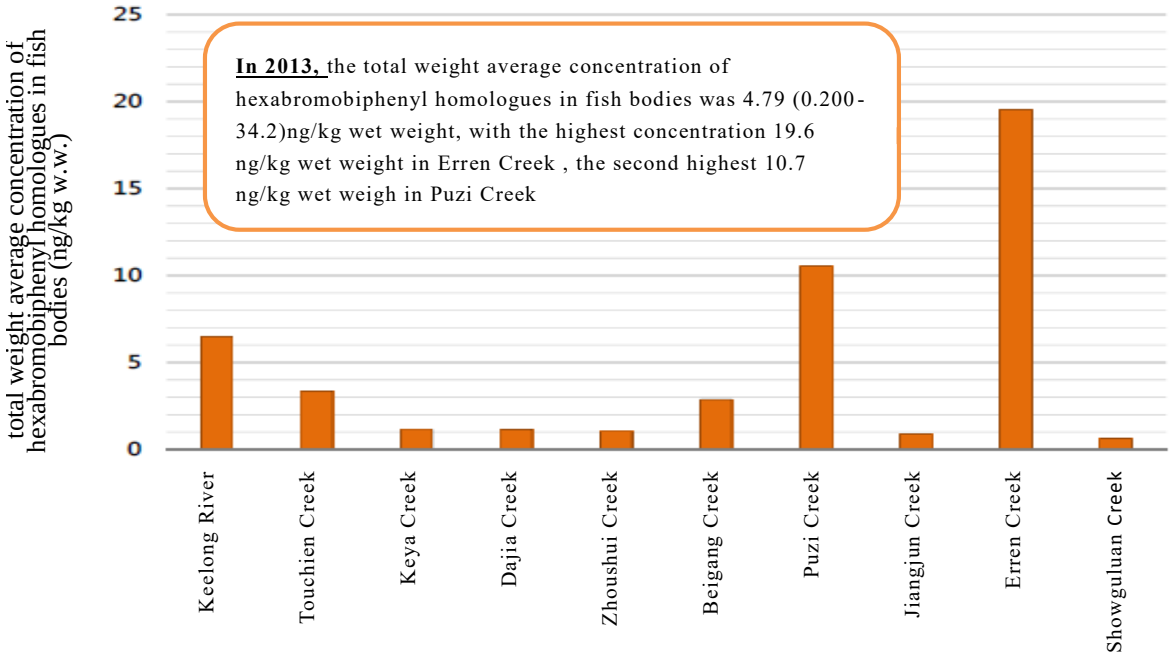
In summary of the environmental distribution investigation of hexabromobiphenyl in river sediments by EPA since 2013, there have been 30 rivers that completed the investigation. In the most recent investigation (from 2018 to 2019), the total weight average concentration of hexabromobiphenyl in the sediments of 30 rivers is shown in Figure 10. Erren Creek had the highest value, with average concentration over 500 ng/kg dry weight, and the average concentrations for other rivers during dry season were all below 40ng/kg dry weight.

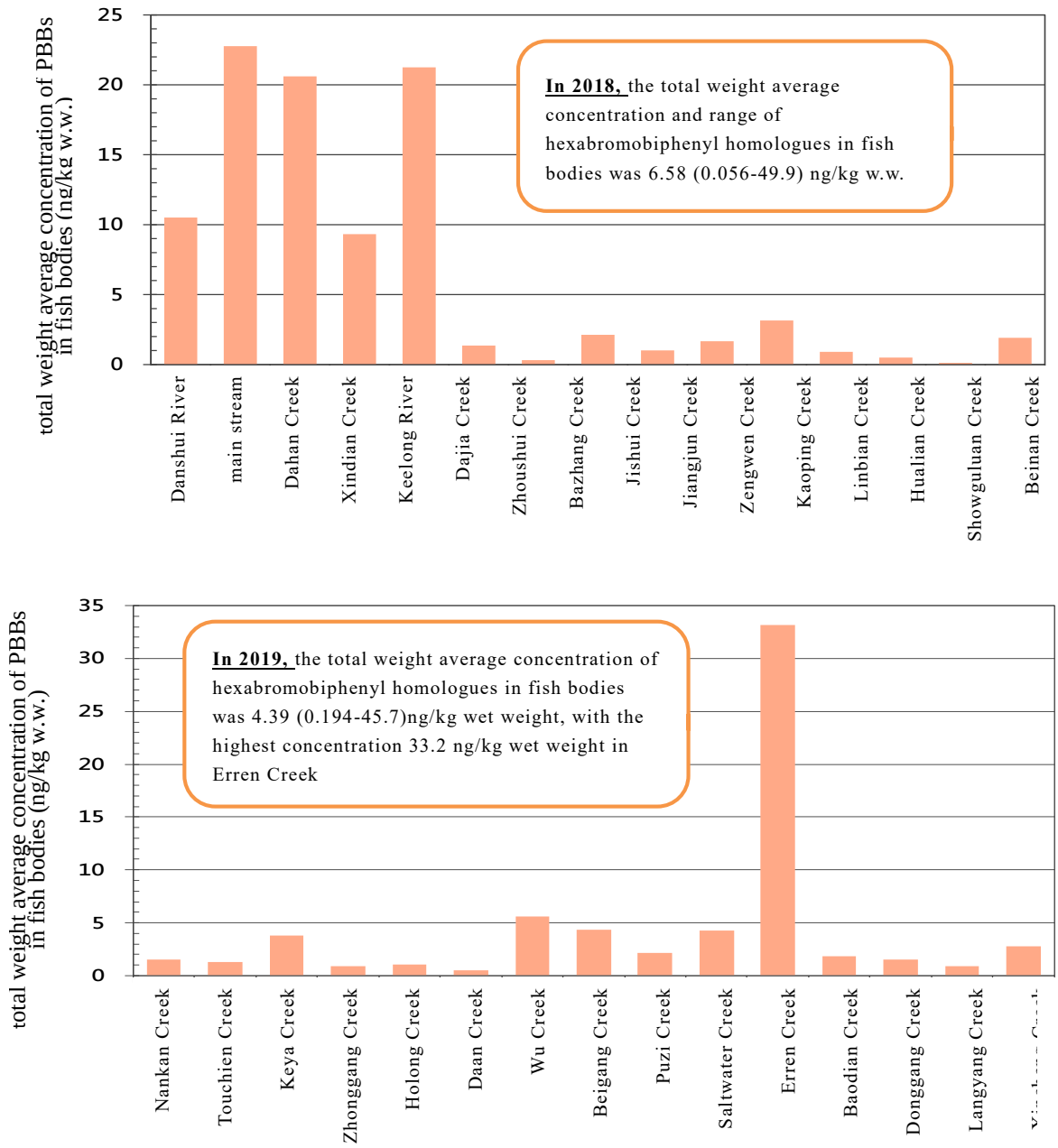
For river fish body, the total weight average concentration and range of 5 hexabromobiphenyl homologues in fish bodies during the river investigation in 2013-2019 is shown in Figure 11



Data source：2019 Background investigation of environmental distribution of chemical substances and release management strategy plan by the Toxic and Chemical Substances Bureau of EPA.

Figure 10. Distribution of total weight average concentration of hexabromobiphenyl in sediments of 30 domestic rivers from the most recent investigation





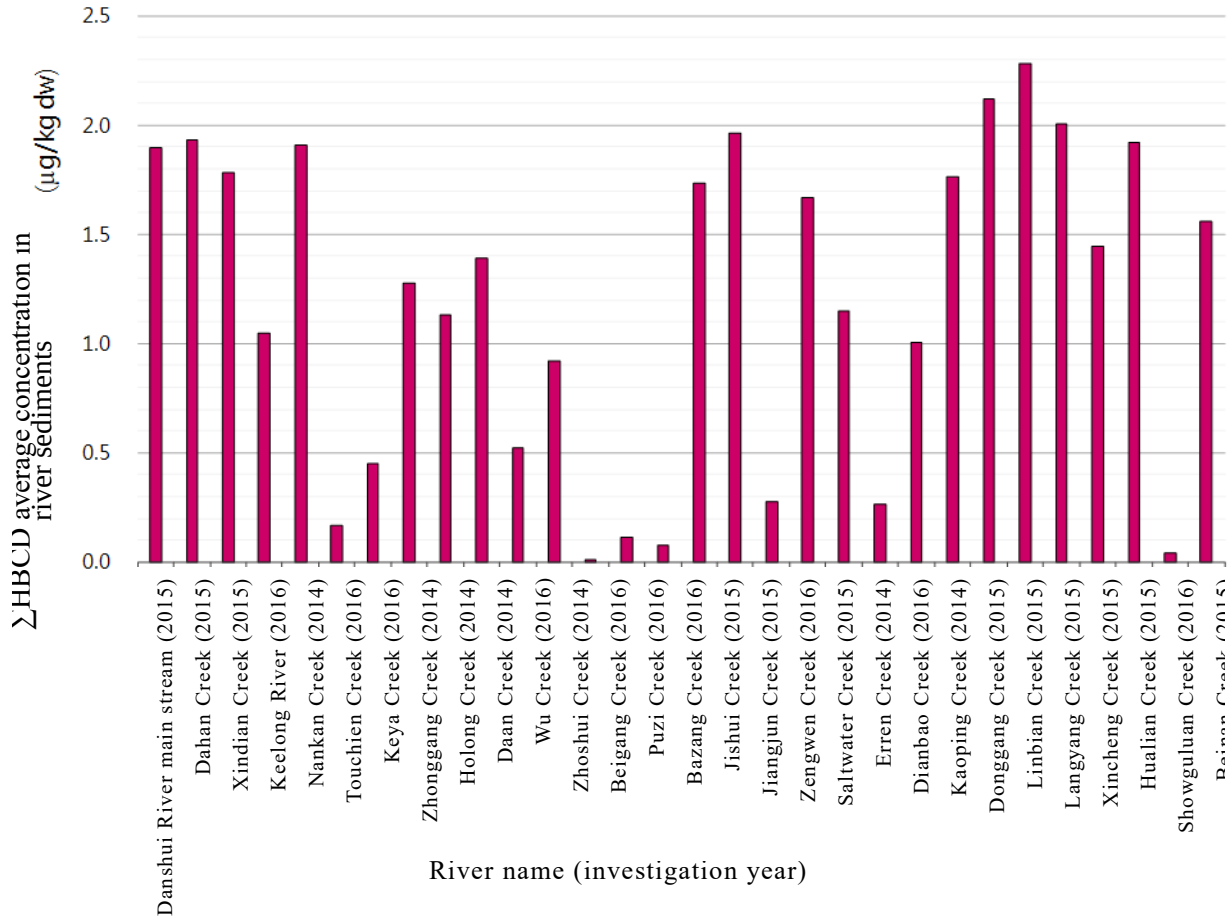
Data source：The Toxic and Chemical Substances Bureau of EPA, the Executive Yuan, 2013-2015, Toxic chemical substances environmental distribution background investigation plan（first year）.2018 Toxic chemical substances environmental distribution background investigation plan, 2019 Toxic chemical substances environmental distribution background investigation and release management strategy plan.

Figure 11　2013-2019 Total weight average of hexabromobiphenyl in river fish bodies

(C) Hexabromocyclododecane

Since 2013, the Department of Environmental Sanitization and Toxic Substance Management of EPA（now Toxic and Chemical Substances Bureau） has conducted the river environmental distribution investigation of hexabromocyclododecane (HBCD), and until 2016 it has accumulated the data of hexabromocyclododecane content in samples from 30 rivers. The average concentration

distribution of hexabromocyclododecane in samples from rivers over the years is shown in Figure 12 Among all, the values for Donggang Creek, Langyang Creek, and Xinchung Creek in 2014 were slightly higher, and the 2015 investigation result showed the values decreasing. In summary the total weight average concentration and range of hexabromocyclododecane was 1.12 (ND~2.28) μg/kg dry weight, and the concentration was not high and lower than that of foreign rivers.



Data source：Toxic chemical substances environmental distribution background investigation plan, EPA of the Executive Yuan

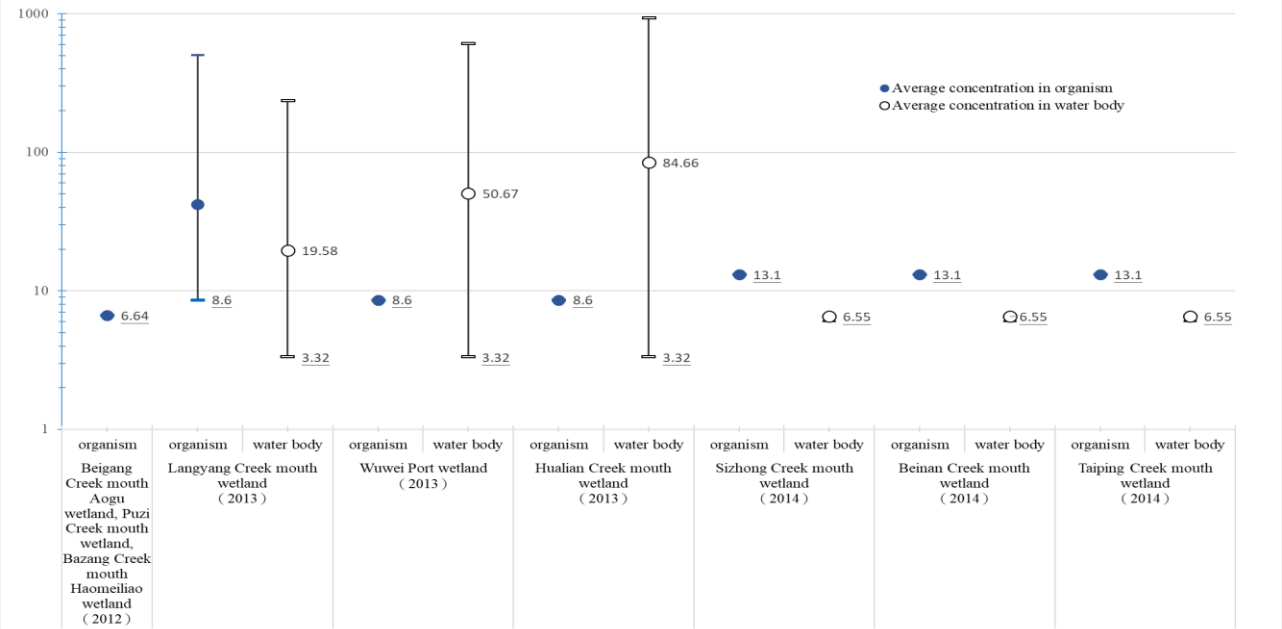
Figure 12 The total weight average concentration of hexabromocyclododecane in river sediments over the years

B.Perfluorooctane sulfonic acid

(A) Wetland organism and water bodies

During 2012-2014, the Bureau of Environmental Inspection of EPA tested 9 sites of wetland and found biological concentration content range was ND - 504.3 ng/g wet weight, and water body concentration range was ND-931 ng/L. For detailed results, see

Figure 13



wetland	Beigang Creek Koaogu wetland, Puzi Creek mouth wetland, Bazhang Creek mouth Haomeiliao wetland (2012)	Langyang Creek mouth wetland (2013)		Wuwei Port wetland (2013)		Hualian Creek wetland (2013)		Sizhong Creek mouth wetland (2014)		Beinan Creek mouth wetland (2014)		Taiping Creek mouth wetland (2014)	
type	organism	organism	Water body	organism	Water body	organism	Water body	organism	Water body	organism	Water body	organism	Water body
minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
maximum	ND	504.3	235	ND	608	ND	931	ND	ND	ND	ND	ND	ND
average	ND	42.03	19.58	ND	50.67	ND	84.66	ND	ND	ND	ND	ND	ND

Note 1：organism unit ng/g wet weight；water body unit ng/L.

Note 2：In 2012, wetland organism detection limit was 6.64 ng/g.In 2013, the detection limits were organism 8.6 ng/g and water body 3.32 ng/L. In 2014, the detection limits were organism 13.1 ng/g and water body 6.55 ng/L. It is expressed by underlined numbers.

Figure 13 2012-2014 results of wetland organism and water body perfluorooctane sulfonic acid

(B) Environmental（rivers and mountain lakes）water bodies

In 2019, the Bureau of Environmental Inspection of EPA investigated the concentration of perfluorooctane sulfonic acid in Sanyegong Creek, Nankan River, Saltwater Creek , and Taliaokeng Creek was N.D. (MDL=1.94ng/L)~3,904 ng/L. In summary of investigation in 2006-2019, the results of concentration of perfluorooctane sulfonic acid in river water bodies and mountain lakes are in Table 18.

Table 18 Concentration of perfluorooctane sulfonic acid in environmental water body（rivers and mountain lakes）

year	river estuary	Concentration range（average）	Number of samples
2006	4 rivers: Dahan River, Keelung River, Kaya Creek（including Sanxingong Creek）and Jiangjun Creek	ND- 7.74 μg/L (1.20 μg/L)	38
2007	7 rivers: Nankan River, Zhonggang Creek, Fangshan Creek, Jian Creek, Xindian Creek, Jinmei Creek and Danshui River	ND-17.3 μg/L (0.10 μg/L)	64
2008	8 rivers: Laojie Creek, Dongshan River, Wu Creek, Hojing Creek, Erren Creek, Nuchou Creek, Dahan River and Keelung River	ND-0.083 μg/L (0.014 μg/L)	54
2009	7 rivers: Saltwater Creek, Tainan Cannal, Jishui Creek, Danshui River, Zhuoshui Creek, Xinhuwei Creek, Ai River	(0.00616 μg/L)	30
2010	10 rivers: Fazi Creek, Wu Creek, Xinhuwei Creek, Nuchouken Creek, Dajia Creek, Old Zhuoshui Creek, Zhuoshui Creek, Kaoping Creek, Donggang Creek, Linbian Creek	ND-0.862 μg/L	47
2017	10 sites of mountain lakes and rivers	ND- 12.6 ng/L （ detection limit0.18 ng/L）	-
2019	4 rivers: Sanyegong Creek, Nankan River, Saltwater Creek , Taliaokeng Creek	N.D. ~3, 904 ng/L （ detection limit1.94ng/L）	484

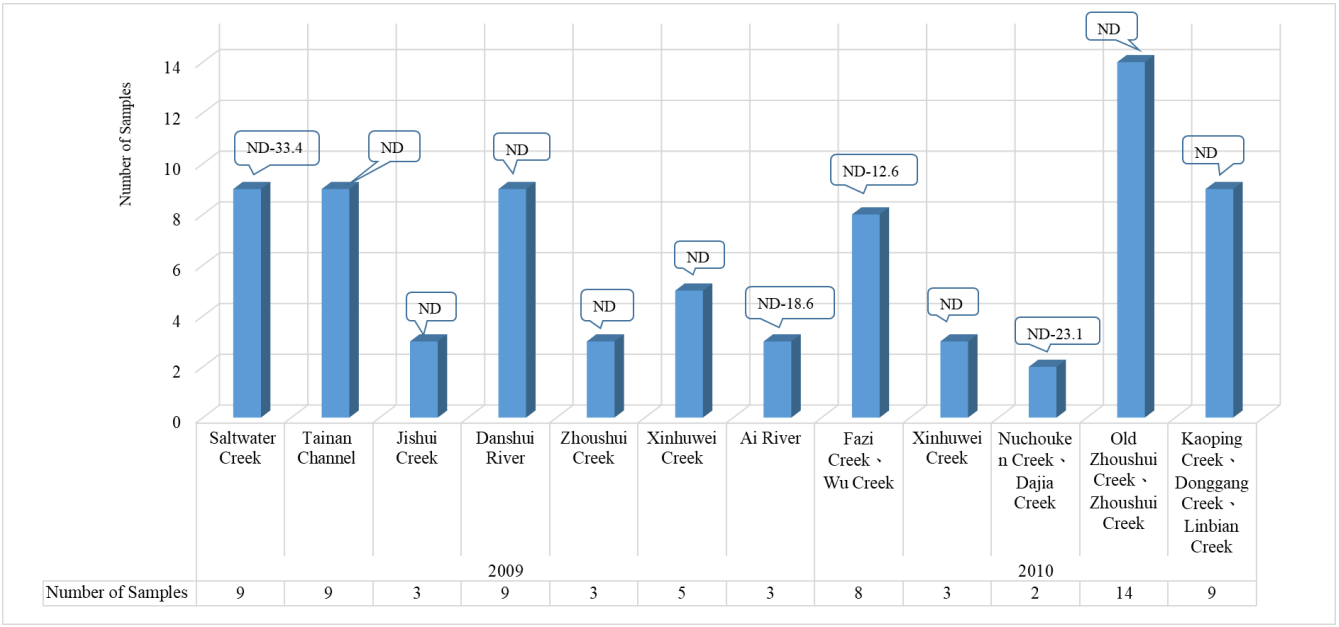
(C) River sediments

In 2018, the Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of concentrations of perfluorooctane sulfonic acid and its salts and perfluorooctyl sulfonate fluoride (PFBS, PFHxS, PFOS, PFHxA, PFOA, PFNA, PFDA, PFUA, PFDoA) in 29 samples of river sediments (including Kaya Creek, Wu Creek, Saltwater Creek), and the concentrations of most samples of sediments were lower than the method detection limit or the quantitation limit (PFOS MDL= 0.67 ng/g, PFOA MDL= 0.62 ng/g), and only near the joint place of the discharged water outlet from Hsinchu Science Park along Kaya Creek estuary, and the discharged water outlet near the middle Taiwan Science Park along Wu Creek estuary, trace PFOS was detected, at concentration

1.98 ng/g and 1.57ng/g, respectively, and several samples from Saltwater Creek were detected for perfluorooctane sulfonic acid and its salts and perfluorooctyl sulfonate fluoride, and maximum concentration of PFOS 21.4 ng/g.

(D) River organism

During 2009-2010, the Bureau of Environmental Inspection of EPA conducted investigation of environmental concentration of perfluorooctane sulfonic acid in 77 samples of organism from 17 rivers, and most samples were ND. For detailed results, see Figure 14



Note：The text box in the figure indicates concentration range (μg/L).

Figure 14 Results of concentration of perfluorooctane sulfonic acid in river organism

(E) Water Purification Plant

In 2019, the Department of Environmental Sanitization and Toxic Substance Management of EPA conducted investigation of PFOS in clear water from 50 sites of water purification plants（now executed by Department of Water Quality Protection ）, and the range was ND（method detection limit 1.2 ng/L）～87 ng/L. For the summary of the water quality data for water purification plant tested by the Bureau of Environmental Inspection of EPA from 2017 to 2018, please see Table 19.

Table 19 Results of concentration of perfluorooctane sulfonic acid in water from water purification plant tested by the Bureau of Environmental Inspection of EPA

year	2017（note 1）	2018（note1）	2019（note2）
Investigation target	Original water and clear water from water purification plant	Original water and clear water from water purification plant	Clear water from water purification plant
	30 sites	40 sites	50 sites
Concentration range	ND（method detection limit 0.18 ng/L）- 48.4 ng/L	ND（method detection limit 0.5 ng/L）～40.6 ng/L	1 site detected for concentration 87 ng/L, the remaining 49 sites not detected（method detection limit 1.2 ng/L）

Note1：In 2017-2018 the Bureau of Environmental Inspection conducted investigation for PFOS concentration.
Note2：In 2019, the Department of Environmental Sanitization and Toxic Substance Management conducted the investigation（now executed by Department of Water Quality Protection）.

(F) Environmental Soils

In 2019, the Soil and Groundwater Remediation Fund Management Board of EPA conducted monitoring of 4 sites as potential PFOS pollution source（24 samples）, concentration ND～34.9（average concentration 2.28）μg/kg, and conducted monitoring of general environmental baseline content （62 samples）, concentration ND～6.64（average concentration 0.575）μg/kg. In 2017 and 2019, the investigation result shows that the science park and general soil baseline contents were found for trace PFOS. For details, see Table 20.

Table 20. Summary of perfluorooctane sulfonic acid content in domestic environmental soils

year	2017		2019	
investigation location	Soils from 3 locations in science parks of intense manufacture of wafer and semiconductor using perfluorinated compound（24 samples）	General soil baseline content（26 samples）	Soils from 4 sites of PFOS as potential pollution source（24 samples）	General environmental baseline content（62 samples）
result	0.12-10.1（average 1.92）	0.07-2.32（average 0.67）	ND～34.9（average 2.28）	ND～6.64（average 0.575）

Note：unit：μg/kg. In 2019, PFOS detection limit was 0.047 μg/kg.

(G) Groundwater

In 2015, the Soil and Groundwater Remediation Fund Management Board of EPA focused on specialty chemicals and pharmaceutical biotechnology industries of emerging pollutants to conduct investigation for 29 samples of groundwater from 11 companies, and the results of perfluorooctane sulfonic acid in 16

samples were all ND. In 2019, the investigation of perfluorinated compounds in groundwater from optoelectronic semiconductor and textile industries continued, and on-site audits and interviews were completed for 50 optoelectronic semiconductor companies and 4 wastewater treatment plants, and 64 samples of groundwater were obtained；besides, 16 textile companies were selected as investigation target for process original water and discharged water, and 29 samples of groundwater were obtained. The test result of perfluorooctane sulfonic acid in groundwater from optoelectronic semiconductor industry was ND~4, 767 ng/L； the test result of perfluorooctane sulfonic acid in groundwater from textile industry was ND~171 ng/L（the method detection limit of perfluorooctane sulfonic acid was 1 ng/L）.

(H) Industrial discharged water

In recent years, the Department of Water Quality Protection of EPA conducted investigation of perfluorooctane sulfonic acid in industrial discharged water, and the result showed the concentration was in ppt level, or mostly lower than the method detection limit. For details, see Table 21. In 2019, water quality investigation was conducted for the industries operating with raw materials possibly containing perfluorooctane sulfonic acid（printing and finishing industry, textile industry and chemical industry etc.）. In 10 times of investigation of discharged water or controlled water, the concentrations of perfluorooctane sulfonic acid were all below the method detection limit.

In 2019, the Soil and Groundwater Remediation Fund Management Board of EPA completed sampling and testing of process water and discharged water from 50 optoelectronic semiconductor companies and 16 textile companies, and the test result of perfluorooctane sulfonic acid in wastewater/ discharged water from optoelectronic semiconductor industry was ND~398 ng/L, and the test result of perfluorooctane sulfonic acid in wastewater/ discharged water from textile industry was ND~18.7ng/L(the method detection limit of perfluorooctane sulfonic acid was 1 ng/L）.

Table 21 Summary of investigation of perfluorooctane sulfonic acid in domestic industrial discharged water

year	Investigated industry type	Number of samples	Investigation result
2010	designated sewer system for optoelectronic materials and component manufacturing, and science industrial park	12	• The concentrations of perfluorooctane sulfonic acid in discharged water from optoelectronic materials and components industry were all below the method detection limit (33 ng/L) • The concentration of perfluorooctane sulfonic acid in discharged water from the designated sewer system for science parks was ND ~ 3,758 ng/L
2011	Wafer manufacture and semiconductor manufacture	20	The concentration was ND-34 ng/L（ detection limit was 33 ng/L）, most below the method detection limit
2017	Designated sewer system and public sewer system for hospitals, industrial areas, or science parks	8	Was ND（the method detection limit was 5 ng/L）-74 ng/L
2019	Industries operating with raw materials possibly containing perfluorooctane sulfonic acid (printing and finishing industry, textile industry and chemical industry）	20	• Among 10 times of investigation of industrial original water, 3 times found the concentration of perfluorooctane sulfonic acid below the method detection limit (2.05 ng/L), and the remaining were 2.45~24.3 ng/L • Besides, the concentrations from 10 times of investigation of perfluorooctane sulfonic acid in discharged water or controlled water were all below the method detection limit (2.05 ng/L).

C. Other industrial chemical substances

(A) Polychlorinated biphenyl

a. River sediment, water bodies and organism

In 2002 and 2004, the Department of Environmental Sanitization and Toxic Substance Management of EPA（now Toxic and Chemical Substances Bureau）completed investigation of PCBs in sediments and fish bodies from 22 domestic rivers, and in 2013 selected 3 rivers, Touqian Creek, Dajia Creek, Erren Creek, for PCBs environmental distribution investigation in every 10 years, and the total weight average concentration is shown in Figure 15 For river sediments, among 22 rivers in 2004, Donggang Creek had the highest concentration of PCBs in sediments, about 54 μg/kg dry weight, and in 2013, 3 rivers were selected for investigation of PCBS in river sediments, and the result was lower than in the past,

indicating a decreasing trend of domestic PCBs in environment；for river fish bodies, the average concentration and range was 1.10 (ND-9.68) μg/kg wet weight; and for the polychlorinated biphenyl content in river water bodies, either in 2002 or 2013, the investigation results were fairly low, and mostly ND.

Besides, during 2007-2017, the Bureau of Environmental Inspection of EPA investigated the concentration of polychlorinated biphenyl in domestic river sediments, and showed it was decreasing year by year, and it also showed the positive result of domestic control of polychlorinated biphenyl. For details, see Figure 16 During 2009-2010, the concentration of polychlorinated biphenyl in river organism from Danshui River, Zhuoshui Creek, Xinhuwei Creek, Jishui Creek, Saltwater Creek , Ai River, Fazi Creek, Wu Creek, Nuchouken Creek, Dajia Creek, Kaoping Creek, Donggang Creek and Linbian Creek was investigated and the average concentration was ND-12.5 μg/kg wet weight, and the concentration of polychlorinated biphenyl in river organism from most rivers was low or ND, indicating insignificant biological concentrating effect.

Besides, in 2018 and 2019, the Soil and Groundwater Remediation Fund Management Board of EPA investigated the concentration of polychlorinated biphenyl in river sediment and reservoir sediments (see Table 22 for results), and only some samples of sediments were detected for trace polychlorinated biphenyl, with concentration 0.00419～0.0162 mg/kg, but all the concentration of polychlorinated biphenyl in all samples of sediments was below the sediments quality index lower limit (0.09 mg/kg).

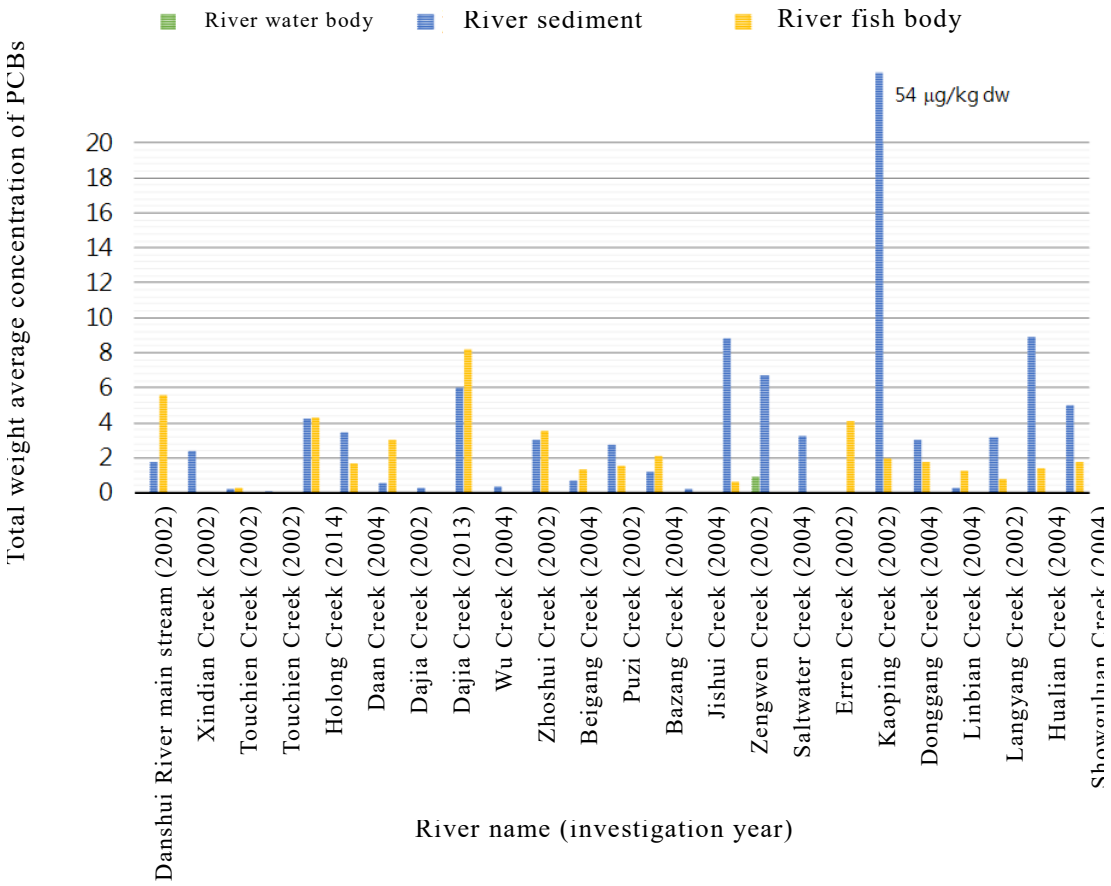
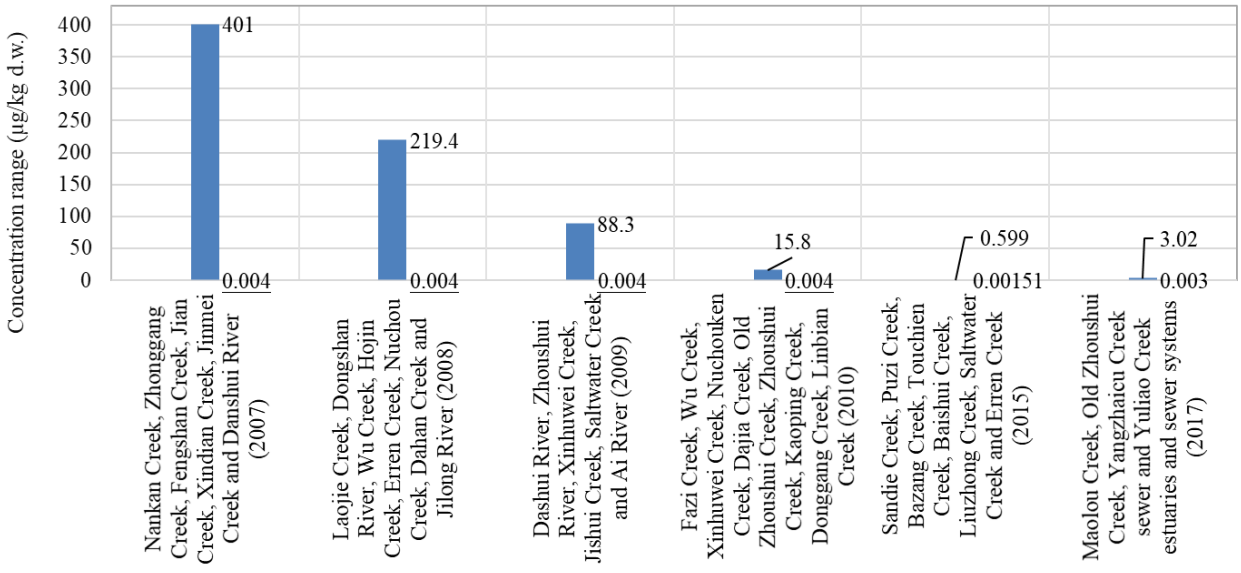


Figure 15 Test result of PCBs in domestic river



Note：The detection limit of polychlorinated biphenyl homologues is 0.0003-0.004 μg/kg, and it is expressed as 0.004μg/kg with underline.

Figure 16 Test result of PCBs in domestic river sediments

Table 22 Investigation result of concentration of polychlorinated biphenyl in sediments from domestic rivers and reservoirs

year	Investigation location and amount	Investigation result
2018	25 samples of sediments from Sung Creek, Narcissus Creek, Saltwater Creek	Only samples of sediments near the Xidinglia Bridge (originally Taiping Bridge) in Saltwater Creek estuary, Anshun Bridge and Changdaokeng in Narcissus Basin were detected for trace polychlorinated biphenyl, concentrations at 0.00458, 0.00927 and 0.00483 mg/kg, respectively.
	10 samples pf sediments from Xinshan Reservoir	・Samples of sediments from 5 sites were detected for trace polychlorinated biphenyl, concentration 0.00419～0.0162 mg/kg ・All samples of sediments had concentration of polychlorinated biphenyl below sediments quality index lower limit (0.09 mg/kg)
2019	13 samples of river sediments	All below the method detection limit or quantitation limit

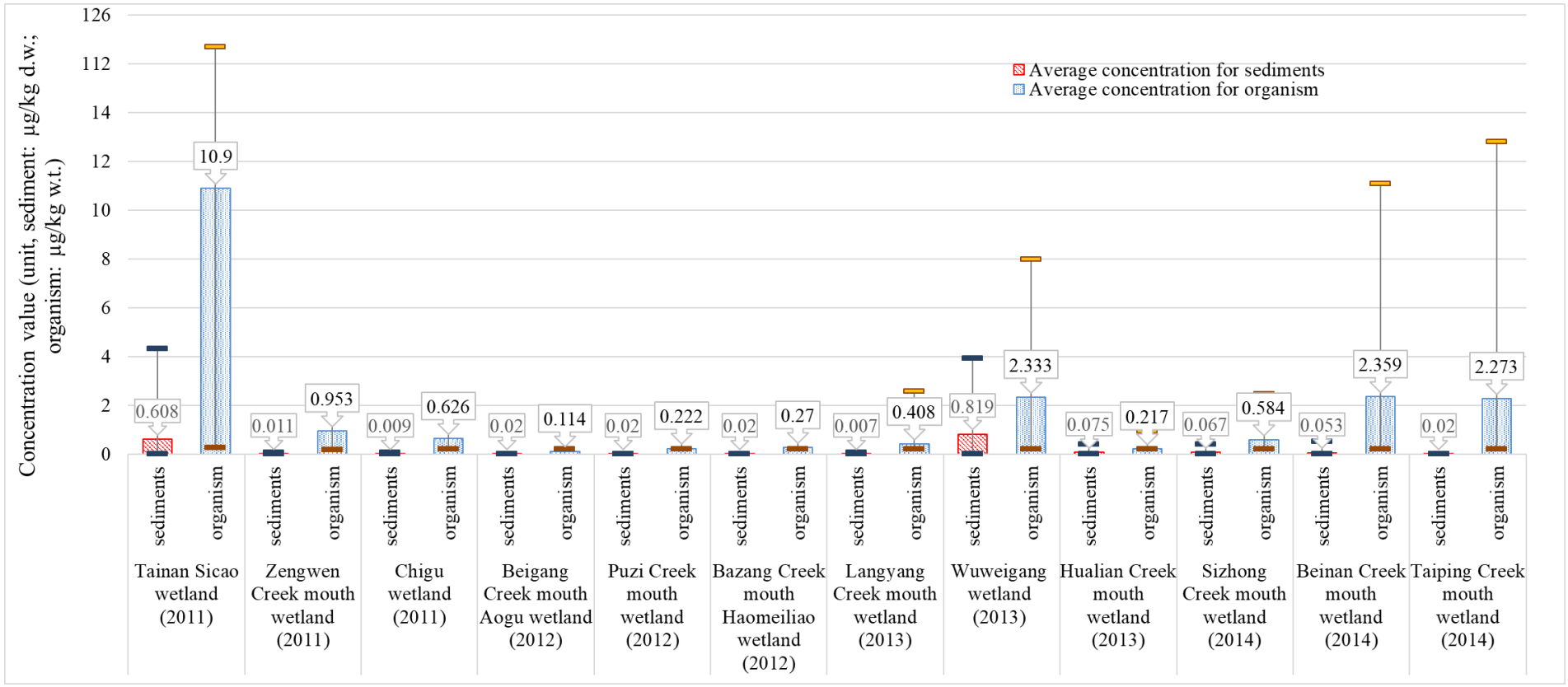
Note：In 2018 polychlorinated biphenyl MDL=0.00418 mg/kg and 2019 MDL=0.00442 mg/kg, QDL=0.019 mg/kg.

b. Wetland sediments and organism

During 2011-2014, the Bureau of Environmental Inspection of EPA tested the concentration range of polychlorinated biphenyl in wetland sediments as ND-4.34 μg/kg dry weight, all below domestic sediment quality index lower limit (0.09 mg/kg) (increasing test frequency）；the concentration range of polychlorinated biphenyl in wetland organism was ND-117（average concentration range 0.114-10.9）μg/kg wet weight. For detailed results, see Figure 17, which indicates achievement in domestic prohibition of polychlorinated biphenyl.

c. Irrigation channel sediments

In 2016, the Soil and Groundwater Remediation Fund Management Board of EPA completed investigation of concentration of polychlorinated biphenyl in 15 samples of irrigation channel sediments, the concentrations of polychlorinated biphenyl in all sediments were below the method detection limit (MDL=0.00304 mg/kg).



wetland（year）	Tainan Sicao wetland (2011)		Zengwen Creek mouth wetland (2011)		Chigu wetland (2011)		Beigang Creek Koaogu wetland (2012)		Puzi Creek mouth wetland(2012)		Bazhang Creek mouth Haomeiliao wetland (2012)		Langyang Creek mouth wetland (2013)		Wuweigang wetland(2013)		Hualian Creek mouth wetland (2013)		Sizhong Creek mouth wetland (2014)		Beinan Creek mouth wetland (2014)		Taiping Creek mouth wetland (2014)	
type	sediments	organism	sediments	organism	sediments	organism	sediments	organism	sediments	organism	sediments	organism	sediments	organism	sediments	organism	sediments	organism	sedements	organism	sediments	organism	sediments	organism
minimum	ND	0.282	ND	0.175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
maximum	4.34	117	0.064	2.47	0.079	2.39	ND	1.31	ND	1.19	ND	1.37	0.079	2.591	3.93	7.985	0.4	0.956	0.4	2.483	0.529	11.096	ND	12.82
average 值	0.608	10.9	0.011	0.953	0.009	0.626	ND	0.114	ND	0.222	ND	0.27	0.007	0.408	0.819	2.333	0.075	0.217	0.067	0.584	0.053	2.359	ND	2.273

Note：wetland sediments unit is μg/kg dry weight（detection limit is 0.020 μg/kg）；organism unit is μg/kg wet weight（detection limit is 0.20 μg/kg）.

Figure 17　Distribution of concentration of polychlorinated biphenyl in domestic wetland sediments and organism

d. Environmental soils

In 2017 and 2019, the Soil and Groundwater Remediation Fund Management Board of EPA focused on the surrounding lands of polychlorinated biphenyl as potential pollution source and general environmental soils, and investigated polychlorinated biphenyl contents, as shown in Table 23, and the results were all below domestic soils PCBs control standard 0.09 mg/kg.

Table 23 Investigation result of PCBs in domestic environmental soils

year	investigation location and amount	Investigation result
2017	19 companies of past polychlorinated biphenyl capacitor manufacture sites, large polychlorinated biphenyl capacitor treatment organizations and past polychlorinated biphenyl capacitor storage sites and users（60 samples）	The concentration for surrounding lands of potential pollution source was ND~0.04 mg/kg（average 0.007 mg/kg）, most were low or ND（detection limit was 0.00253 mg/kg）
	general environmental baseline content（40 samples）	The concentration was ND~0.043 mg/kg（average 0.00378 mg/kg）
2019	Focus on 17 companies of the monitoring points in 2017 of higher polychlorinated biphenyl value, paint manufacturing factories, ASR treatment organizations（29 samples）	The concentration for surrounding lands of potential pollution source was ND～0.0227 mg/kg（average concentration 0.00357 mg/kg）, most were low or ND（detection limit was 0.00234 mg/kg）
	General environmental baseline content（62 samples）	The concentration was ND（detection limit was 0.00234 mg/kg）

e. Industrial and wastewater treatment plant discharged water

Since polychlorinated biphenyl has its specified limit value in discharged water standard, in recent years according to the control limit in the discharged water standard, EPA conducted testing and nonconforming companies were subject to regulatory penalties. In recent years, all industrial discharged water complied with the regulation.

(B) Pentachlorophenol and its salts, esters

During 2011-2015, the Department of Environmental Monitoring and Information Management of EPA investigated concentration of pentachlorophenol in water from domestic rivers, reservoirs, and sea areas and found ND for all (detection limit was 0.005 mg/L), and all complied with 「Environmental standards for protecting human health」of 「Water quality standards for surface water bodies」and 「Marine environmental quality standards for protecting human health」 of「Marine environmental classification and marine environmental quality standards」.

Pentachlorophenoland its salts have its specified limit value in the discharged water standards, and our domestic discharged water complied with the regulation.

In 2019, the Soil and Groundwater Remediation Fund Management Board of EPA conducted monitoring of soils of pentachlorophenol potential pollution source for 20 sites （40 samples） and monitoring of general environmental baseline content （62 samples）, and found all ND（detection limit was 0.017 mg/kg）, and all complied with domestic soil pollution control standards.

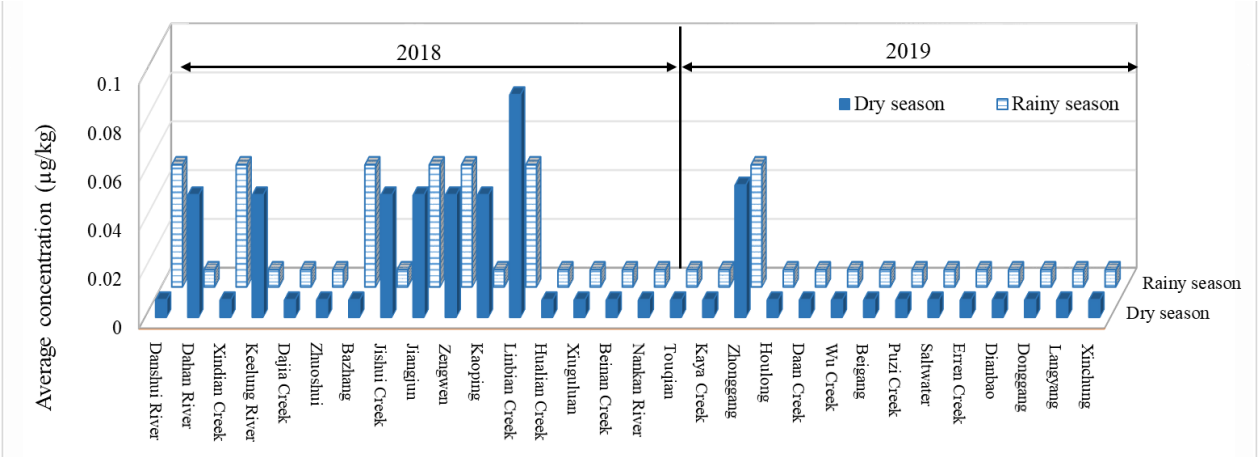
(C) Hexachloro-1, 3 butadiene

a. River sediments and fish bodies

In 2019, the Toxic and Chemical Substances Bureau of EPA analyzed hexachlorobutadiene in 15 rivers and the result the average concentration and range of 122 samples of sediments was <0.05(ND-0.204) μg/kg dry weight. In dry season, Zhonggang Creek average had 0.054 μg/kg dry weight, as the highest concentration, and one sample was detected positive, while other samples were detected negative；in rainy season all 15 rivers were not detected for any hexachlorobutadiene, indicating after river sediments were flushed, the environmental hexachlorobutadiene decreased to the quantitative range（0.05μg/kg dry weight）. For details, see Figure18 The average concentration average and range of hexachlorobutadiene in fish bodies from 15 rivers was <0.1 (ND-0.691) μg/kg dry weight and <0.025 (ND-0.138) μg/kg wet weight, and only the sample of fish body from Zhonggang Creek was detected positive, with highest concentration 0.691μg/kg dry weight （0.138 μg/kg wet weight）, indicating the hexachlorobutadiene content and detection rate of river sediment and fish body were low.

The summary of total weight average concentration of hexachlorobutadiene in sediments from 30 rivers from 2018 to 2019 average is shown in Figure 19 Linbian Creek and Zhonggang Creek average had relatively higher concentration, but lower than the quantitative range（0.05 μg/kg dry weight）. The distribution of total weight average concentration of hexachlorobutadiene in river fish

bodies is shown in Figure 20. Zhonggang Creek average had highest concentration（0.308μg/kg dry weight, 0.062μg/kg wet weight）, and the remaining were all ND or lower than the quantitative range （<0.1μg/kg dry weight, <0.025μg/kg wet weight）.

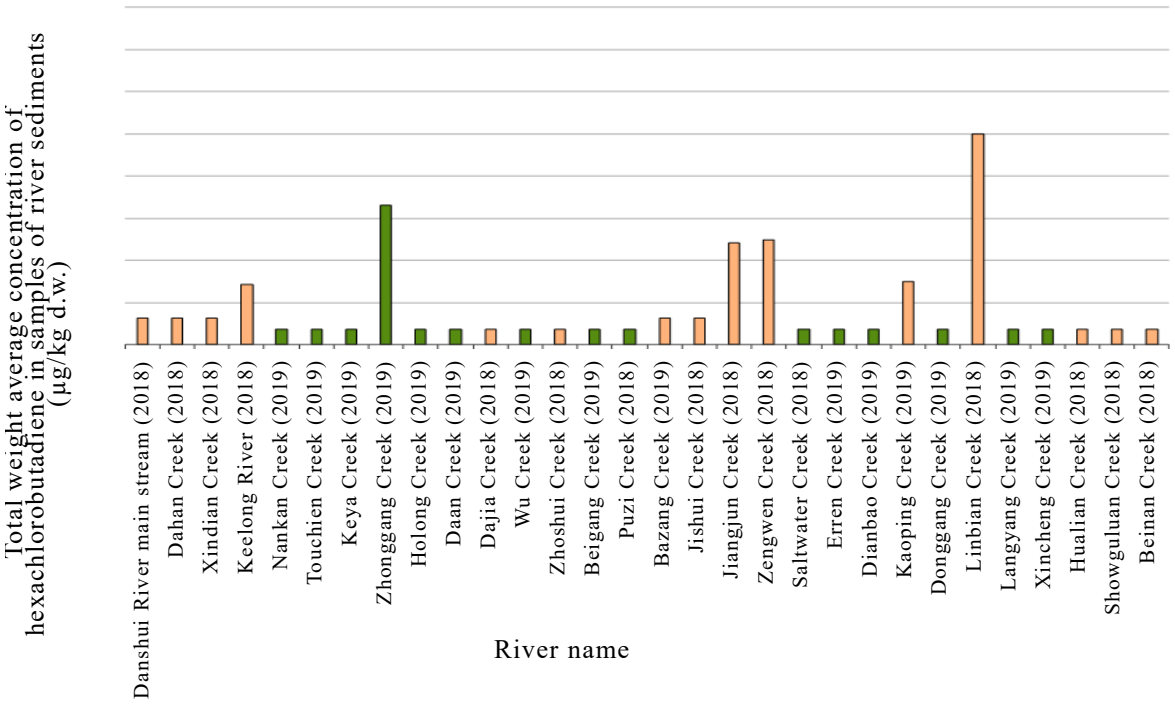


	2018																2019													
River	Danshui	Dahan River	Xindian	Keelung	Dajia Creek	Zhuoshui	Bazhang	Jishui Creek	Jiangjun	Zengwen	Kaoping	**Linbian**	Hualian	Xiuguluan	Beinan Creek	Nankan River	Touqian	Kaya Creek	**Zhonggang**	Houlong	Daan Creek	Wu Creek	Beigang	Puzi Creek	Saltwater	Erren Creek	Dianbao	Donggang	Langyang	Xinchung
Dry season	N D	<0.05	N D	<0.05	N D	N D	N D	<0.05	<0.05	<0.05	<0.05	**0.091**	N D	N D	N D	N D	N D	N D	**0.054**	N D	N D	N D	N D	N D	N D	N D	N D	N D	N D	N D
Rainy season	<0.05	N D	<0.05	N D	N D	N D	<0.05	N D	<0.05	<0.05	N D	**<0.05**	N D	N D	N D	N D	N D	N D	**<0.05**	N D	N D	N D	N D	N D	N D	N D	N D	N D	N D	N D

Data source：The Toxic and Chemical Substances Bureau of EPA, the Executive Yuan, 2019 Chemical substances environmental distribution background investigation and release management strategy plan. 2018 Chemical substances environmental distribution background investigation plan

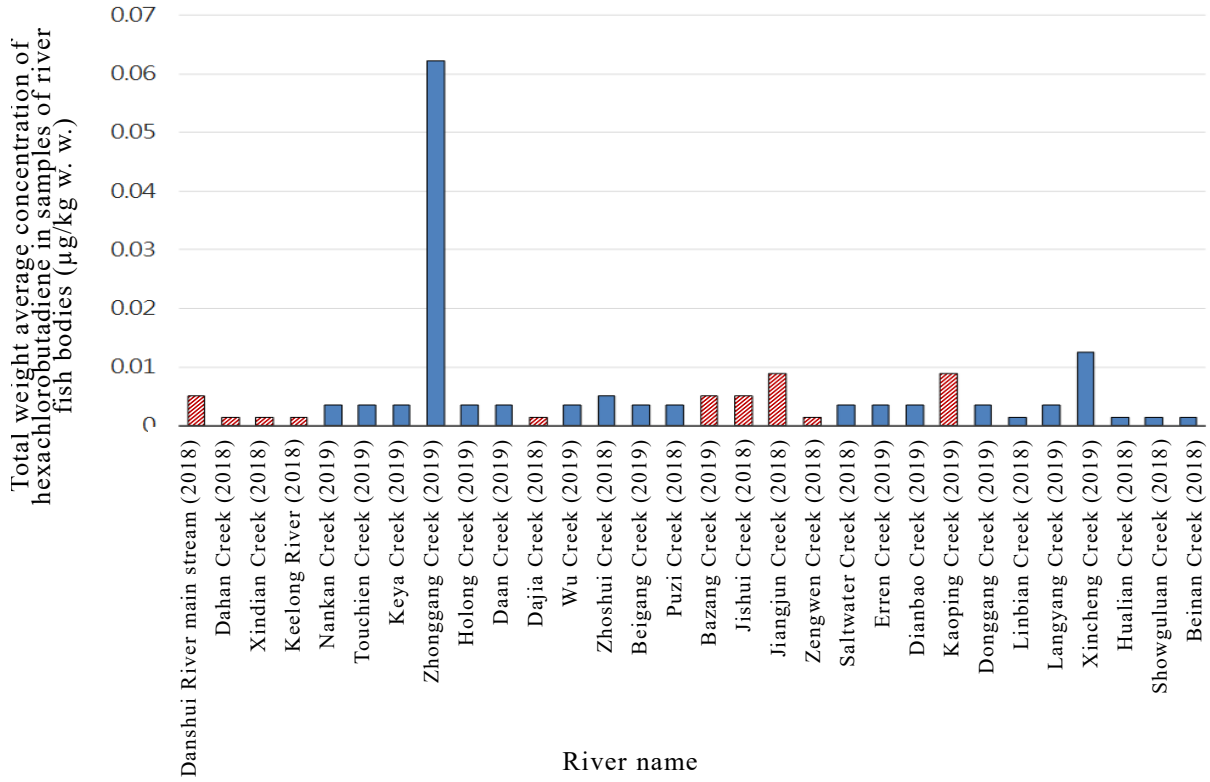
Note：The test value is lower than the method detection limit 0.007 μg/kg dry weight, by ND；the test value is lower than the minimum quantitative concentration (LOQ=0.05μg/kg dry weight), expressed by < minimum quantitative concentration (adding actual test value).

Figure 18 Result of average concentration of hexachlorobutadiene in river sediments tested by the Toxic and Chemical Substances Bureau of EPA in 2018~2019



Data source：The Toxic and Chemical Substances Bureau of EPA, the Executive Yuan, 2019 Chemical substances environmental distribution background investigation and release management strategy plan.

Figure 19　Distribution of total weight average concentration of hexachlorobutadiene in sediments of 30 domestic rivers



Data source：The Toxic and Chemical Substances Bureau of EPA, the Executive Yuan, 2019 Chemical substances environmental distribution background investigation and release management strategy plan.

Figure 20.　Distribution of total weight average concentration of hexachlorobutadiene in fish bodies of 30 domestic rivers

b. Environmental soils

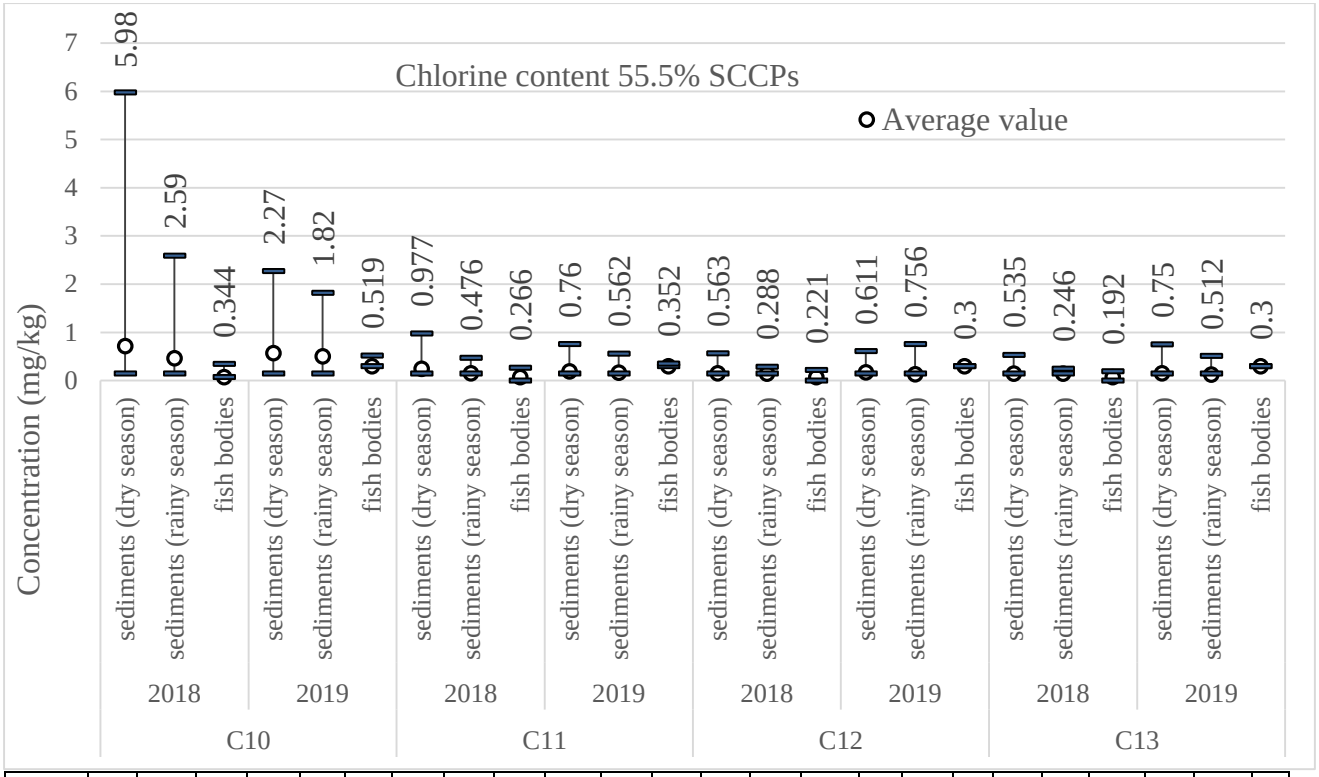
In 2019, EPA conducted monitoring of 20 sites of soils of hexachlorobutadiene potential pollution sources（40 samples）and monitoring of general environmental baseline content(62 samples), and all were ND （detection limit was 0.019 mg/kg）.

(D) Short-chain chlorinated paraffin

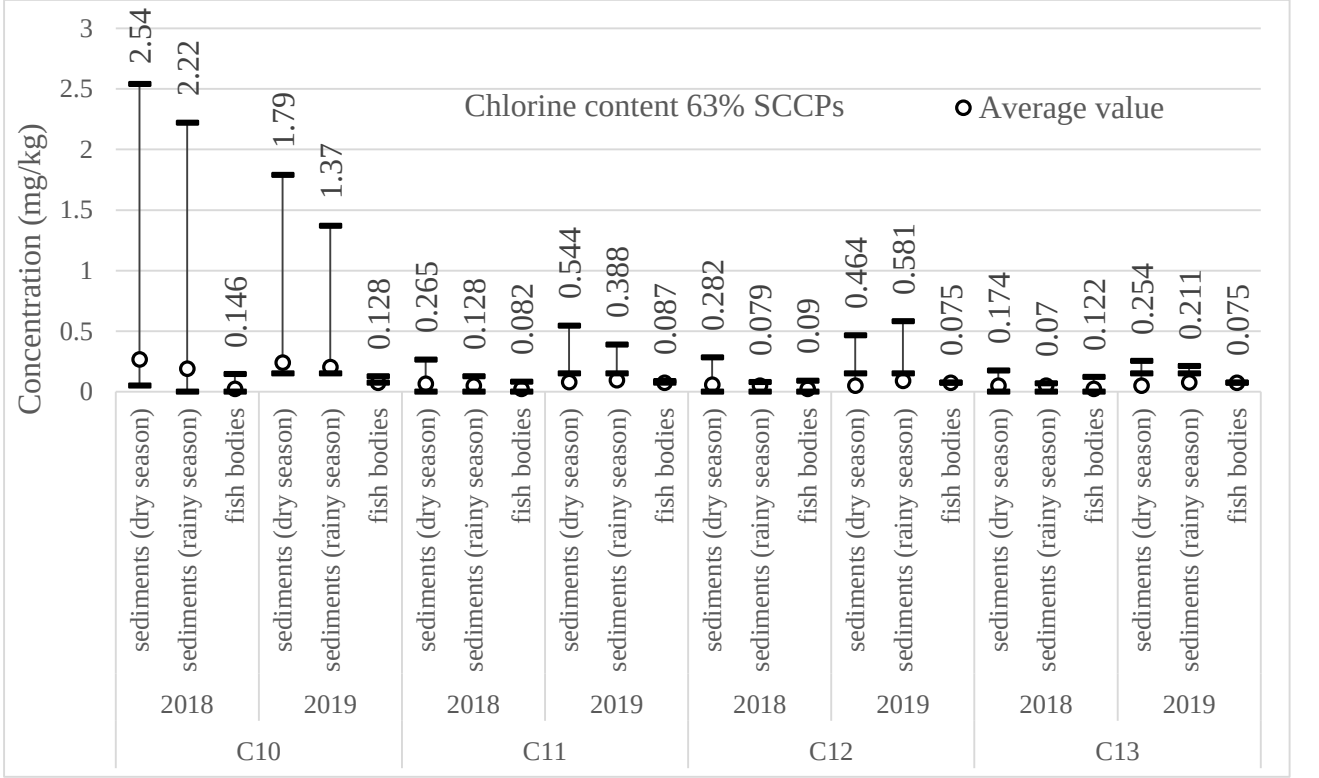
In 2017, the Toxic and Chemical Substances Bureau of EPA conducted analysis of short-chain chlorinated paraffin (SCCPs) for the first time, and in 2019 continued the analysis of 122 samples of sediments and 45 samples of fish bodies from 15 rivers. For detailed results, please see Figure 21 and 22, both show the SCCPs of chlorine content 55.5% were higher than the SCCPs of chlorine content 63%. And in river sediments, for both SCCPs of chlorine content 55.5% and the SCCPs of chlorine content 63%, Erren Creek had the highest total amount, with average concentration 2.35 mg/kg dry weight and 1.66 mg/kg d.w.. The summary of the 2017-2019 investigation data of 30 domestic rivers（for details, see Figure 22）shows that domestic rivers all had higher SCCPs of chlorine content 55.5% than SCCPs of chlorine content of 63%, and all with higher concentration in low carbon number C10, and among all, for SCCPs of 55.5% chlorine content in river sediments, Danshui River main stream had the highest average concentration 3.18 mg/kg dry weight, and Erren Creek had the second highest 2.35 mg/kg dry weight；for SCCPs of 63% chlorine content in river sediments, Danshui River mainstream and Erren Creek average had the highest concentration 1.65 mg/kg d.w..

(E) Chlorinated naphthalene

In 2019, the Soil and Groundwater Remediation Fund Management Board of EPA conducted monitoring of soils of 3 sites of surrounding lands of chlorinated naphthalene potential pollution source (6 samples), with concentration 27.0-128 （average concentration 62.4） ng/kg, and conducted monitoring of general environmental baseline content（22 samples）, with concentration 7.84-199（average concentration was 53.4）ng/kg.



	C10						C11						C12						C13					
	2018			2019			2018			2019			2018			2019			2018			2019		
	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies
average	0.716	0.469	<0.075	0.574	0.509	<0.3	0.247	0.153	<0.075	0.192	0.167	<0.3	0.155	<0.15	<0.075	0.172	0.135	<0.3	<0.15	<0.15	<0.075	0.157	0.13	<0.3
minimum	<0.15	<0.15	<0.075	<0.15	<0.15	<0.3	<0.15	<0.15	ND	<0.15	<0.15	<0.3	<0.15	<0.15	ND	<0.15	<0.15	<0.3	<0.15	<0.15	ND	<0.15	<0.15	<0.3
maximum	5.98	2.59	0.344	2.27	1.82	0.519	0.977	0.476	0.266	0.760	0.562	0.352	0.563	0.288	0.221	0.611	0.756	<0.3	0.535	0.246	0.192	0.75	0.512	<0.3

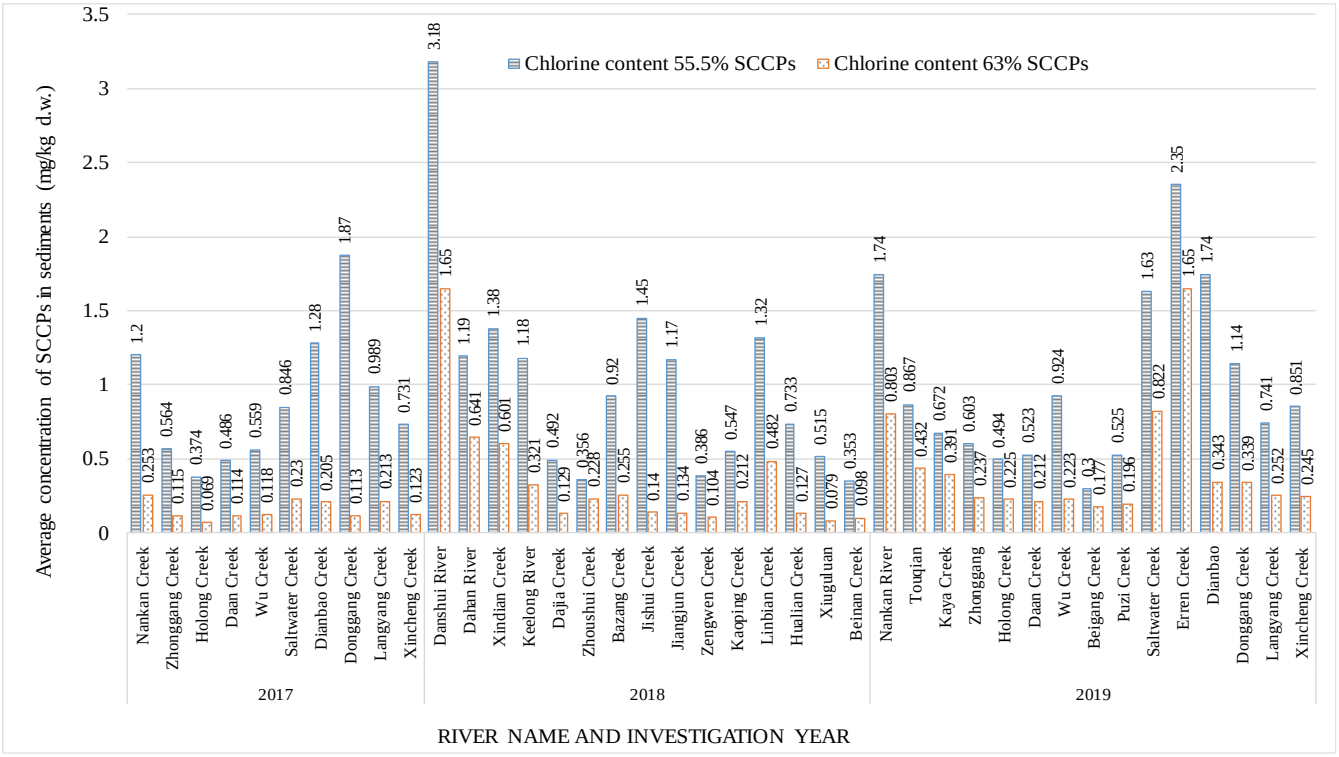


	C10						C11						C12						C13					
	2018			2019			2018			2019			2018			2019			2018			2019		
	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies	sediments (dry season)	sediments (rainy season)	fish bodies
average	0.267	0.191	<0.025	0.240	0.203	<0.075	0.065	<0.05	<0.025	0.08		0.096	<0.075	0.057	<0.05	<0.025	<0.050	0.090	<0.075	<0.05	<0.05	<0.025	0.051	0.076	<0.075
minimum	<0.05	ND	ND	<0.15	<0.15	<0.075	ND	ND	ND	<0.15		<0.15	<0.075	ND	ND	ND	<0.15	<0.15	<0.075	ND	ND	ND	<0.15	<0.15	<0.075
maximum	2.54	2.22	0.146	1.79	1.37	0.128	0.265	0.128	0.082	0.544		0.388	0.087	0.282	0.079	0.090	0.464	0.581	<0.075	0.174	0.070	0.122	0.254	0.211	<0.075

Data source：The Toxic and Chemical Substances Bureau of EPA, the Executive Yuan, 2018 Chemical substances environmental distribution background investigation plan, 2019 Chemical substances environmental distribution background investigation plan and release management strategy plan

Unit: sediments mg/kg dry weight；fish body mg/kg wet weight

Figure 21 Average concentration and range of SCCPs in sediments and fish bodies of 15 rivers in 2018-2019



Data source: The Toxic and Chemical Substances Bureau of EPA, the Executive Yuan, 2016-2017 Toxic chemical substances environmental distribution background investigation plan, 2018 chemical substances environmental distribution background investigation plan, 2019 chemical substances environmental distribution background investigation and release management strategy plan

Figure 22 Distribution of total weight average concentration of SCCPs in sediments of 30 domestic rivers

(III). Unintentional derivatives-dioxin and furan

A. Environmental air

To establish domestic long-term trend of dioxin concentration variation in atmosphere, since 2007 environmental air quality monitoring of dioxin has been conducted. To understand the dioxin concentration variation in every city over the years, since 2011 dioxin monitoring at each local station has been conducted in every season, and the items include polychlorinated dioxin, polychlorinated furan, and dioxin type polychlorinated biphenyl. During 2006-2019, the average concentration of dioxin was 0.021-0.051 pg I-TEQ/m^3（Figure 23）, the and the average monitoring concentration 0.089 pg I-TEQ/m^3 in 2003 was significantly lower than that in 2002, and all monitoring values over the years were much lower than the Japanese「Environmental dioxin air quality standard value」0.6 pg WHO2005-TEQ/m^3, which is the only standard in the world.

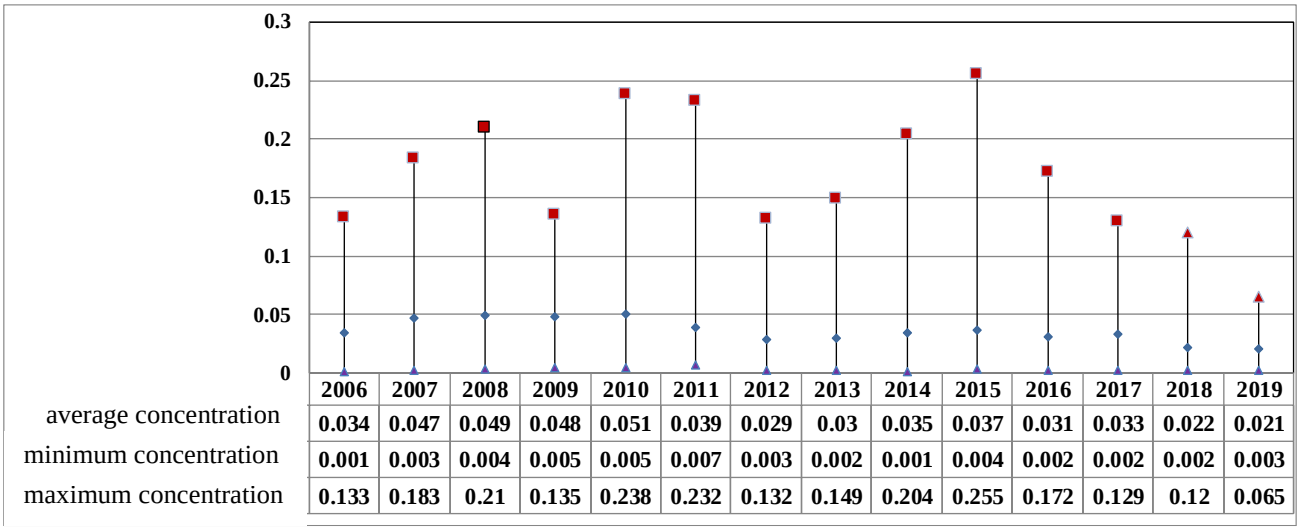


Figure 23 Monitoring concentration of dioxin and furan in general air quality monitoring station over the years

B. Sediments and organism in rivers and irrigation ditches

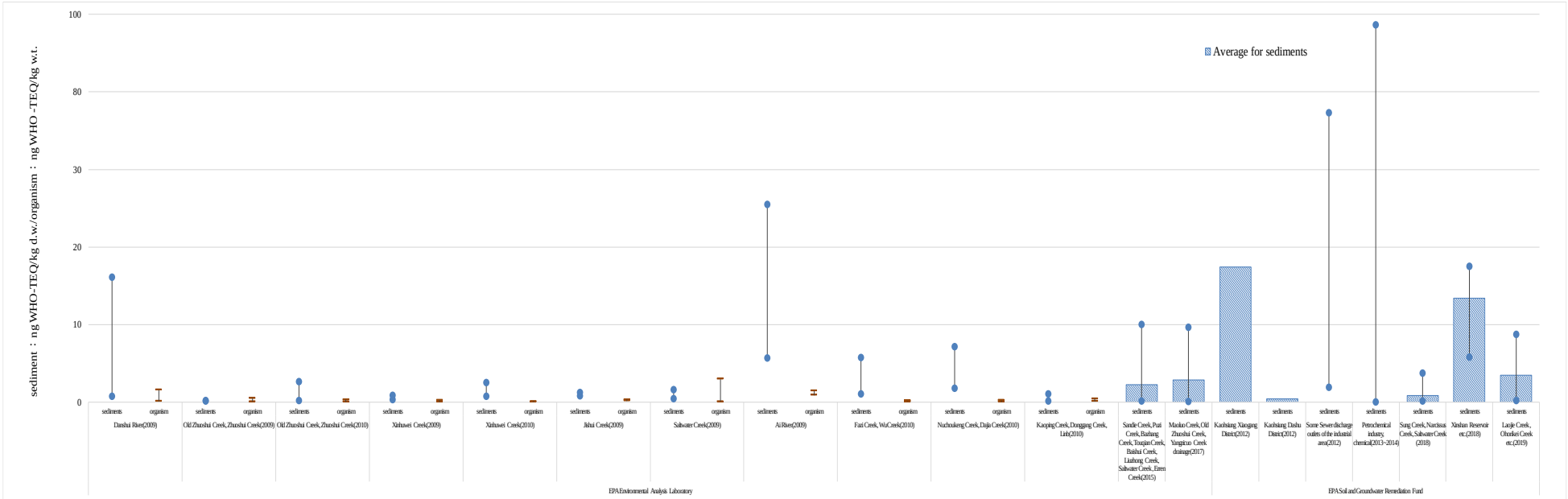
For river sediments and organism, from 2009 to 2010 and from 2015 to 2017, the Bureau of Environmental Inspection of EPA investigated the total dioxin toxic equivalent concentration content in river sediments to be 0.048-25.5 ng WHO-TEQ/kg dry weight, and in organism to be 0.02-2.95 ng WHO-TEQDF/kg wet weight, and in both river sediments and organism the dioxin toxic equivalent concentration was not high. For details, see Figure 24

In addition, in 2012 the Soil and Groundwater Remediation Fund Management Board of EPA analyzed the dioxin content in sediments from Kaohsiung Xiaogang District (within Linhai industrial area), Dashu District and some sewer discharge outlets of the industrial area, and in Xiaogang District（within Linhai industrial area）the average concentration in sediments（17.4 ng I-TEQ/kg dry weight）was higher than that in Dashu District without stationary pollution source（0.395 ng I-TEQ/kg dry weight）, and the concentration in the sediments from the industrial area was 1.89-74.6 ng I-TEQ/kg dry weight. From 2013 to 2014, EPA focused on petrochemical industry and chemical industry to conduct 37 times of groundwater investigation, and focused on pollution potential area within the factories and the concerned detected pollutants in groundwater to conduct 4 times of sediment investigation, and found dioxin was ND~97.3 ng I-TEQ/kg. In 2018, EPA conducted investigation of concentration of dioxin and furan in 35 river sediments

（including Sung Creek, Narcissus Creek, Saltwater Creek）and reservoir sediments（Xinshan Reservoir）, and found only 1 sample of reservoir sediments lower than the sediments quality index lower limit, and all others exceeded the sediments quality index lower limit. In 2019, EPA conducted investigation of concentration of dioxin and furan in 13 samples of river sediments, and found the concentration range was 0.185～8.700（average value 3.470）ng I-TEQ/kg, among those, Xucuogang No.1 Bridge of Laojie Creek, Huanxiang Bridge and New Ohorikei Creek Bridge of Ohorikei Creek exceeded the sediments quality index lower limit (6.82 ng I-TEQ/kg). For details, see Figure 24

For irrigation ditches, in 2016, the Soil and Groundwater Remediation Fund Management Board of EPA completed the investigation of concentration of dioxin and furan in sediments from 15 irrigation ditches, and the concentration range was 1.49～19.3（average value was 5.40）ng I-TEQ/kg, and 3 samples of sediments had the concentration of dioxin and furan over the sediments quality index lower limit (6.82 ng I-TEQ/kg).

Besides, in 2019, the Bureau of Environmental Inspection of EPA investigated 30 river and ditch monitoring points in Kaoping area, and found the total toxic equivalent range for dioxin in sediments was 0.005 -5.64（average value was 0.819）WHO-TEQ/kg d.w., and the distribution range of total toxic equivalent of dioxin polychlorinated biphenyl was 0.00003 - 0.696 ng WHO-TEQ/kg d.w.

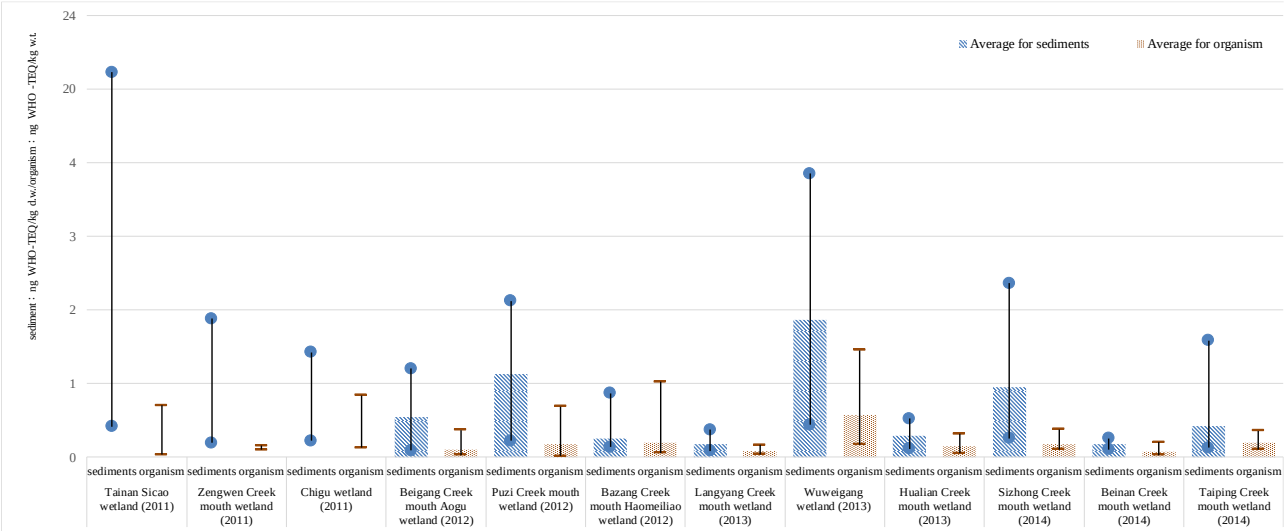


river estuary	year	sediments	organism
Danshui River	2009	0.72-16.1	0.10-1.54
Old Zhuoshui Creek, Zhuoshui Creek	2009	0.16-0.21	0.06-0.50
	2010	0.208-2.63	0.020-0.298
Xinhuwei Creek	2009	0.29-0.88	0.02-0.25
	2010	0.723-2.52	0.049-0.059
Jishui Creek	2009	0.83-1.22	0.16-0.31
Saltwater Creek	2009	0.41-1.62	0.07-2.95
Ai River	2009	5.71-25.5	0.89-1.42
Fazi Creek, Wu Creek	2010	1.06-5.76	0.068-0.139
Nuchoukeng Creek, Dajia Creek	2010	1.80-7.15	0.022-0.216
Kaoping Creek, Donggang Creek,	2010	0.164-1.03	0.076-0.412
Sandie Creek, Puzi Creek, Bazhang Creek, Tougian	2015	0.152-10.0 (average 2.21)	—
Maoluo Creek, Old Zhuoshui Creek, Yangzicuo Creek drainage	2017	0.048-9.64 (average 2.87)	—
Kaohsiung Xiaogang District	2012	17.4 (average)	—
Kaohsiung Dashu District	2012	0.395 (average)	
Some Sewer discharge outlets of the	2012	1.89-74.6	
Petrochemical industry,	2013-2014	ND~97.3	—
Sung Creek, Narcissus Creek,	2018	0.137-3.71 (average 0.819)	—
Xinshan Reservoir etc.	2018	5.83-17.5 (average 13.4)	—
Laojie Creek, Ohorikei Creek etc.	2019	0.185-8.7 (average 3.470)	—

Figure 24 Distribution of total toxic equivalent concentration of dioxin in sediments and organism from rivers (including reservoirs)

C.Wetland sediments and organism

During 2011-2014, the Bureau of Environmental Inspection of EPA focused on wetland sediments and organism to conduct investigation of toxic equivalent concentration dioxin and furan. For detailed results, please see Figure 25 The average value range for wetland sediments was 0.064-4.10 ng WHO-TEQ/kg dry weight, and the average value range for organism was 0.071-0.575 ng WHO-TEQ/kg wet weight. In general, the equivalent concentration of dioxin in both wetland sediments and organism was not high.



wetland	Tainan Sicao	Zengwen Creek mouth	Chigu	Beigang Creek Koaogu	Puzi Creek mouth	Bazhang Creek mouth Haomeiliao	Langyang Creek mouth	Wuwei Port	Hualian Creek mouth	Sizhong Creek mouth	Beinan Creek mouth	Taiping Creek mouth
sediments maximum	20.9	1.88	1.42	1.2	2.12	0.867	0.37	3.85	0.52	2.36	0.254	1.58
sediments minimum	0.411	0.191	0.22	0.089	0.217	0.133	0.081	0.434	0.112	0.252	0.103	0.124
sediments average	0.064 - 4.10			0.543	1.13	0.251	0.173	1.86	0.292	0.952	0.176	0.42
organism maximum	0.701	0.154	0.835	0.366	0.685	1.02	0.161	1.45	0.313	0.373	0.201	0.356
organism minimum	0.031	0.099	0.127	0.026	0.012	0.055	0.036	0.167	0.049	0.103	0.027	0.102
organism average	0.119 - 0.390			0.098	0.172	0.191	0.084	0.575	0.149	0.177	0.071	0.189

Sediments unit：ng WHO-TEQ/kg dry weight. Organism unit：ng WHO -TEQ/kg wet weight.

Figure 25　Distribution of total toxic equivalent concentration of dioxin in wetland sediments and organism

D. Groundwater

From 2011 to 2013, the Soil and Groundwater Remediation Fund Management Board of EPA focused on semiconductor and optoelectronic industries to conduct investigation in 51 wells, and found the concentration of dioxin was 0.029~8.13 pg WHO-TEQ/L；from 2013 to 2014, EPA focused on petrochemical and chemical industries to conduct investigation in 37 samples of groundwater and found the highest concentration of dioxin was 0.115 pg I-TEQ/L.

In addition, in 2015, the Bureau of Environmental Inspection of EPA tested 10 groundwater monitoring wells, and found the concentration of dioxin and furan was ND~0.150 pg WHO-TEQ/L, mainly in PCDD/Fs of high chlorine content, and among all, OCDD accounted for 62% on average, and OCDF accounted for 13% of total concentration on average. The concentration of dioxin polychlorinated biphenyl was ND~0.045 pg WHO-TEQ/L, and PCB-118 was the highest, accounting for 46% of total concentration on average, and the second highest was PCB-105 and PCB-77 In 2016, EPA investigated the dioxin content in groundwater from the factories ever operating with decabromodiphenyl ether, and the results from 2 times of investigation were 0.090 and 0.115 pg WHO-TEQ/L, respectively.

E. Drinking water

In 2019, EPA focused on Taichung Shengang water purification plant, Taichung Liyu Lake water purification plant and Keelong Anlo water purification plant to conduct random test of drinking water quality for three times, and the dioxin value was ND（detection limit 0.002087）~0.006 pg WHO-TEQ/L, and all complied with the drinking water standards (3 pg WHO-TEQ/L). During 2007-2019, EPA focused on domestic tap water supply systems to conduct random test of drinking water quality for dioxin for 90 times, and all complied with the drinking water standards.

F. Environmental soils

Since 2011, the Soil and Groundwater Remediation Fund Management Board of EPA has conducted national soil property investigation control plan. In summary of the investigation result of

dioxin in soils during 2011-2017, the investigated concentration of general environmental baseline was 0.701-37.9（average 3.34）ng I-TEQ/kg, and the investigated concentration distribution in high pollution potential and special areas was 0.239 - 217(average was (H)20) ng I-TEQ/kg. In 2019, EPA continued the monitoring of dioxin in soils of 43 sites from lands surrounding potential pollution sources（67 samples）, and the concentration was 0.239～48.6（average 5.34）ng I-TEQ/kg；besides, the monitoring concentration of dioxin of the general environmental baseline content（106 samples）was 0.071～20.3（average was 1.46）ng I-TEQ/kg, and all data were below domestic soil dioxin control standard 1, 000 ng I-TEQ/kg.

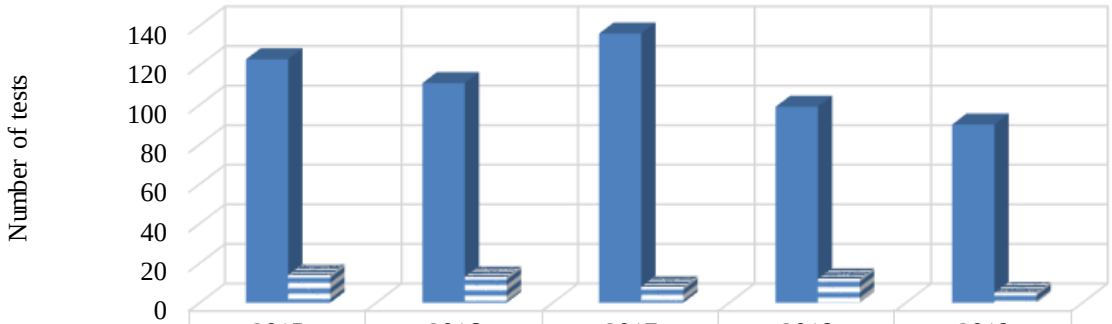
In addition, from 2013 to 2014, EPA focused on petrochemical and chemical industries to conduct investigation of groundwater for 37 times, and focused on pollution potential areas within factories and concerned detected pollutants in groundwater to conduct soil investigation for 4 times, and the soil dioxin investigation result was 15.2 ng I-TEQ/kg, and all were below domestic soil dioxin control standard.

G. Stationary pollution source flue emission

The Department of Air Quality Protection and Noise Control of EPA focused on stationary pollution source to publicize the regular test frequency and reporting system for dioxin and furan and strengthen the emission audit control work every year. According to the Air Pollution Control Act, those who do not comply with emission standards are subject to correction within time limit. For audit results in recent years, see Figure 26 For example, in 2019, the industry conducted the regular audits of emission pipelines dioxin for 449 times, and environmental protection agencies conducted audits of emission pipelines dioxin for 90 times, and among all, 5 audit results were over the limit, and among these, 3 audit results were from waste fueled boilers and 1 result was from industrial waste incinerator and 1 result was from large incinerator, and all were subject to reporting and penalty by environmental protection agencies for ongoing improvement.

In 2019, the Bureau of Environmental Inspection of EPA continued sampling and testing of dioxin from stationary pollution sources for 6 times in total, and the range was 0.005-0.279 ng-

TEQ/Nm^3, which complied with stationary pollution source dioxin emission standard 0.5 ng-TEQ/Nm$^{(C)}$



	2015	2016	2017	2018	2019
Number of audits (times)	123	111	136	99	90
Audit non-conforming	14	13	8	12	5

Note：In 2015, 14 sites were non-conforming, including 9 sites were waste fueled boilers, 1 site was large incinerator, 1 site was medical waste fueled incinerator, 2 sites were cremation fields, and 1 site was dichloroethane manufacturing process. In 2016, 13 sites were non-conforming, including 8 sites were waste fueled boilers, 1 site was small incinerator, 3 sites were cremation fields, and 1 site was secondary copper smelting. In 2017, 8 sites were non-conforming, including 6 sites were waste fueled boilers, 1 site was secondary aluminum smelting, and 1 site was medical waste incinerator. In 2018, 12 sites were over the limit, including 8 sites were waste fueled boilers, 2 sites were cremation fields, 1 site was medical waste incinerator, and 1 site was secondary copper smelting. In 2019, 5 sites were over the limit, including 3 sites were waste fueled boilers, 1 site was industrial waste incinerator, and 1 site was large incinerator.

Figure 26　Audit status of stationary pollution source flue emission by environmental protection agencies

H. Industrial discharged water

Since dioxin and furan in discharged water standards have specified limit values, according to the discharged water standard control value, EPA conducted testing in recent years, and those non-conforming were subject to penalties. For the summary of the industrial wastewater quality investigation results regarding domestic dioxin pollution potential processes by the Department of Water Quality Protection of EPA, please see Table 24 The investigation results over the years indicated that the dioxin concentration from over 90% of the industrial or system discharged water steadily complied with the control limit, and the suspending solid in wastewater was the indicator of dioxin concentration. In addition to reducing the production of dioxin from the source, some processes can also enhance the SS removal efficiency of the process end wastewater and maintain the stable discharge of dioxin.

Table 24 Status of investigation of dioxin and furan in domestic industrial discharged water in recent years

year	Industrial type under investigation	Number of samples	Investigation result
2007	General waste incineration, industrial waste incineration, pulp manufacturing, vinyl chloride manufacturing, epichlorohydrin manufacturing, caprolactam manufacturing, acetylene manufacturing, aluminum alloy manufacturing, zinc recycling, waste disposal sites, public sewer systems, dedicated sewer systems in industrial areas	43 samples of water	• Total emission of dioxin was 0.447 g-I-TEQ/year • All complied with discharged water control standard (10 pg-I-TEQ/L) • The concentration in industrial waste was the highest（maximum value was 9.82 pg I-TEQ/L）, the second highest was pulp manufacturing, vinyl chloride manufacturing, dedicated sewer systems in industrial areas and public sewer systems, and the concentrations of dioxin in industrial discharged wastewater from the remaining were all below 1 pg I-TEQ/L
2012	Industries (including pulp manufacturing, general waste incineration, industrial waste incineration, vinyl chloride manufacturing, aluminum smelting, aluminum alloy casting, steelmaking) or sewage treatment plant	26 samples of water	96% samples of water complied with the control limit 10 pg I-TEQ/L, and those over the limit, after re-test, reduced the concentration significantly
2018	Waste incinerator, caprolactam manufacturing, epichlorohydrin manufacturing, acetylene manufacturing, aluminum alloy manufacturing, zinc recycling manufacturing, waste final disposal site, paper manufacturing, etc.	20 times	Except that the dioxin homologues in wastewater from the pulp manufacturing process and a certain hypochlorous acid sodium and liquid chlorine and other chlorate manufacturing were mainly 2, 3, 7, 8-TCDF, the dioxin in wastewater from other industries was mainly OCDD and OCDF.
2019	Domestic manufacturing processes of dioxin pollution potential.	10 times	All complied with the discharged water control standards (10 pg-I-TEQ/L)

(IV). Conclusions

From the above summary of the testing (monitoring) results of environmental media, it can be shown that currently domestic control has achieved initial progress. The report is based on the achievement of 2019 environmental testing results, with the summary as follows:

A. River sediment and fish bodies

(A) Agro pesticides POPs：Soil and Groundwater Remediation Fund Management Board of EPA conducted investigation of the concentrations of agro pesticides POPs（including Aldrin, Chlordane, DDT, Dieldrin, Endrin, heptachlor, hexachlorobenzene, Toxaphene, Endosulfan） and the derivatives in 13 samples of river sediments and found the concentrations of agro pesticides POPs in most river sediments were below the method detection limit or quantitation limit, and the concentrations for all samples of river sediments were below the quality index lower limit.

(B) Polychlorinated biphenyl：EPA Soil and Groundwater Remediation Fund Management Board conducted the investigation of the concentration of polychlorinated biphenyl in river sediments and found it below the quality index lower limit (0.09 mg/kg).

(C) Dioxin and furan：EPA Soil and Groundwater Remediation Fund Management Board conducted the investigation of concentration in 13 samples of river sediments, with concentration range 0.185 ~ 8.700（average 3.470）ng I-TEQ/kg, and among all, the samples from Xucuogang No.1 Bridge of Laojie Creek, Huanxiang Bridge and New Ohorikei Creek of Ohorikei Creek exceeded the quality index lower limit (6.82 ng I-TEQ/kg). In addition, Bureau of Environmental Inspection, EPA, investigated 30 river monitoring points in Kaohsiung and Pingdong area, and the distribution range of dioxin total toxic equivalent in river sediments was 0.005 -5.64 WHO-TEQ/kg d.w., and the distribution range of total toxic equivalent of dioxin type polychlorinated biphenyl was 0.00003 - 0.696 ng WHO-TEQ/kg d.w.

(D) Polybrominated diphenyl ether：Toxic and Chemical Substances Bureau, EPA in 2019 focused on 15 rivers and conducted the environmental distribution investigation of 25 PBDEs (including

tetrabromodiphenyl ether, hexabromodiphenyl ether, heptabromodiphenyl ether, decabromodiphenyl ether）type POPs. The investigation result shows that the weight average concentration and range of PBDEs in river sediments was 17,943（281-401, 946）ng/kg dry weight. Among 15 rivers, Erren Creek had the highest average concentration in river sediments 82,377 ng/kg dry weight, and the next was Nankan River 78,507 ng/kg dry weight, and there was a decreasing trend in the rivers which had relatively high value in the past, including Kaya Creek and Dianbao Creek. The weight average concentration and range of PBDEs in fish bodies was 502 (48.3-2, 359) ng/kg wet weight.

(E) Hexabromobiphenyl: Toxic and Chemical Substances Bureau of EPA focused on 15 rivers and conducted the environmental distribution investigation of 5 kinds of hexabromobiphenyl in 122 samples of river sediments, and the weight average concentration and range of hexabromobiphenyl homologues in river sediments was 41.5 (0.133-2, 184) ng/kg dry weight, and the concentration in river sediments of some rivers in the rainy season was higher than that in the dry season. The average concentration, 575 ng/kg dry weight, for Erren Creek was the highest, the next was Houlong Creek 20.5 ng/kg dry weight. The weight average concentration and range of hexabromobiphenyl homologues in fish bodies was 4.39 (0.194-45.7) ng/kg wet weight, and among all the average concentration 33.2 ng/kg wet weight for Erren Creek was the highest.

(F) Hexachlorobutadiene：Toxic and Chemical Substances Bureau of EPA conducted analysis for 15 rivers, and the average concentration and range for all 122 samples of river sediments was <0.05(ND-0.204) μg/kg dry weight. In dry season, the average concentration 0.054 μg/kg dry weight for Zhonggang Creek was the highest, and one sample analysis was positive, while other rivers were negative; in rainy season, all 15 rivers were negative, indicating river sediments after flushing the environmental hexachlorobutadiene was reduced to below the quantitative range（0.05μg/kg dry weight）. The average concentration and range of hexachlorobutadiene in fish bodies from 15 rivers was <0.1 (ND-0.691) μg/kg dry weight and <0.025 (ND-

0.138) μg/kg wet weight, and among all only the analytical result for fish body from Zhonggang Creek was positive, with the concentration as high as 0.691 μg/kg dry weight（0.138 μg/kg wet weight）, which indicated that the hexachlorobutadiene content and detection rate for river sediments and fish bodies were low.

(G) Short-chain chlorinated paraffin：Toxic and Chemical Substances Bureau of EPA conducted analysis of SCCPs concentration in 122 samples of river sediments and 45 samples of fish bodies from 15 rivers, indicating all had SCCPs of 55.5% chlorine content more than SCCPs of 63% chlorine content. In river sediments, Erren Creek had the highest SCCPs of 55.5% chlorine content and SCCPs of 63% chlorine content, with average concentration 2.35 mg/kg dry weight and 1.66 mg/kg dry weight, respectively.

B. Sediments from Irrigation Ditch：Bureau of Environmental Inspection of EPA investigated 30 river ditch monitoring points in Kaohsiung and Pingdong area, and found the concentration range of agro pesticides POPs was ND-1, 668 ng/kg d.w., fairly low； the range of hexabromodiphenyl ether and heptabromodiphenyl ether was 0.146-163（the average was 130.2）ng/kg d.w.；the range of tetrabromodiphenyl ether and pentabromodiphenyl ether was 1.49-29, 100（the average was 790.6）ng/kg d.w.

C. Environmental water body：Department of Environmental Monitoring and Information Management of EPA monitored 10 monitoring points of rivers and 2 monitoring points of reservoirs, and investigated organochlorine agro pesticides in water（Endrin, Heptachlor, DDT, Aldrin, Dieldrin, Toxaphene, Lindane, Endosulfan）, and found all complied with domestic standards. The Bureau of Environmental Inspection of EPA investigated perfluorooctane sulfonic acid in the river water from Sanyegong Creek, Nankan River, Saltwater Creek, Taliaokeng Creek and found the concentration N.D.(MDL=1.94ng/L)~3, 904 ng/L.

D. Monitoring of dioxin and furan in environmental air: Department of Air Quality Protection and Noise Control of EPA monitored dioxin in environmental air, and found the average concentration 0.021 pg I-TEQ/m^3, significant lower than the average concentration 0.089 pg I-

TEQ/m^3 from 2002 and 2003, and far lower than Japanese 「environmental dioxin air quality standard」 0.6 pg WHO_{2005}-TEQ/$m^{(C)}$

E. Stationary pollution source flue：The industry conducted 449 periodic tests of dioxin from emission pipelines dioxin, and the environmental protection agencies conducted 87 audits on emission pipelines dioxin, and found 4 audits exceeding the standard, and three of them were waster fueled boilers and one was industrial waste incinerator, and they were notified and punished by the environmental protection agencies and subject to continuous improvement. The Bureau of Environmental Inspection of EPA also conducted 6 times of sampling and testing of dioxin from stationary pollution sources, and all complied with the dioxin emission standards for stationary pollution sources.

F. Discharged water：Department of Water Quality Protection of EPA focused on the industry operating with raw materials possibly containing perfluorooctane sulfonic acid（printing and finishing industry, textile industry and chemical industry etc.）and conducted investigation of discharged water or controlled water for 10 times, and found the concentration of perfluorooctane sulfonic acid was below the method detection limit. Soil and Groundwater Remediation Fund Management Board investigated 50 optoelectronic semiconductor companies and 16 textile companies, and the results for perfluorooctane sulfonic acid in wastewater/ discharged water were ND~398 ng/L and ND~18.7ng/L, respectively. The investigation of domestic industrial processes of dioxin pollution potential indicated that all complied with the control standard of dioxin in discharged water.

G. Drinking water：Department of Environmental Sanitization and Toxic Substance Management of EPA focused on domestic municipal water supply systems to conduct drinking water quality sampling and testing for Lindane and Endosulfan for 34 times（now implemented by Department of Water Quality Protection）, including 31 times of municipal water sampling and 3 times of simple municipal water sampling, and the results all complied with drinking water quality standard. PFOS in water from 50 water purification plants was tested and the range was ND (method detection limit 1.2 ng/L）~ 87 ng/L. 3 tests of drinking water quality for water purification plan were conducted, and

dioxin value was ND~0.006 pg WHO-TEQ/L, and all complied with drinking water quality standard.

H. Environmental soil：The Soil and Groundwater Remediation Fund Management Board of EPA conducted soil tests of polybrominated diphenyl ether, PFOS, chlorinated naphthalene, pentachlorophenol, hexachlorobutadiene, dioxin and polychlorinated biphenyl in the surrounding lands of potential pollution sources and general environmental baseline content monitoring. The results for dioxin, polychlorinated biphenyl and pentachlorophenol were far lower than domestic soil pollution control standard; hexachlorobutadiene was not detected, and the average concentrations for polybrominated diphenyl ether, PFOS and chlorinated naphthalene were 38.6 μg/kg, 2.28 μg/kg, and 62.4 ng/kg, and the average concentrations for general environmental baseline content monitoring were 9.90 μg/kg, 0.575μg/kg, and 53.4 ng/kg, respectively.

I. Groundwater: The Soil and Groundwater Remediation Fund Management Board of EPA focused on optoelectronic semiconductor and textile related industries to conduct investigation of perfluorinated compounds in groundwater. The test result of perfluorooctane sulfonic acid in groundwater from optoelectronic semiconductor industry was ND~4, 767 ng/L, and ND~171 ng/L for groundwater from textile industry.

IV. Monitoring results of organism and commercial products

Our country has conducted monitoring and analysis of crops, commercial foods, poultry, livestock and fishery products, and commercial products（for details, see Table 25）. For detailed results, please see the description later.

Table 25 Summary of testing items for POPS in organism and commercial products

Controlled group under the Convention /POPs/ organism		crops	Poultry and livestock products and feeds	aquatic products and aquaculture feed	commercial foods
A	Aldrin	●		●	●
	Dieldrin	●		●	●
	Chlordane	●		●	●
	Endrin	●		●	●
	DDT	●		●	●
	Mirex	●		●	●
	hexachlorobenzene	●		●	●
	Heptachlor	●		●	●
	Toxaphene	●		●	●
	polychlorinated biphenyl			●	
	dioxin	●	●	●	●
	furan	●	●	●	●
B	Lindane	●		●	●
	α- hexachlorocyclohexane	●		●	●
	β- hexachlorocyclohexane	●		●	●
	chlordecone				
	pentachlorobenzene			●	
	hexabromobiphenyl	●			●
	hexabromodiphenyl ether and heptabromodiphenyl ether	●	●	●	●
	tetrabromodiphenyl ether and pentabromodiphenyl ether	●	●	●	●
	perfluorooctane sulfonic acid and its salts and perfluorooctane sulfonate fluoride	●			●
C	Endosulfan	●		●	●
D	hexabromocyclododecane	●			●
E	chlorinated naphthalene				
	hexachloro-1, 3-butadiene				
	pentachlorophenoland its salts, esters				
F	short-chain chlorinated paraffin				
	decabromodiphenyl ether		●	●	●

(I). Organochlorine agro pesticides

A. Crops

The Agriculture and Food Agency of COA analyzed the residual organochlorine agro pesticides in crops like rice, vegetables, and fruits. The number of samples is shown in Figure 27 Except that in 2019, 1 pumpkin sample of 14, 587 samples was detected for Dieldrin（the edible crops on the ground have been eradicated and destroyed, but have not been introduced into the market）, all the others were not detected for any（detection limit：0.01ppm）or complied with food safety and hygiene regulations.

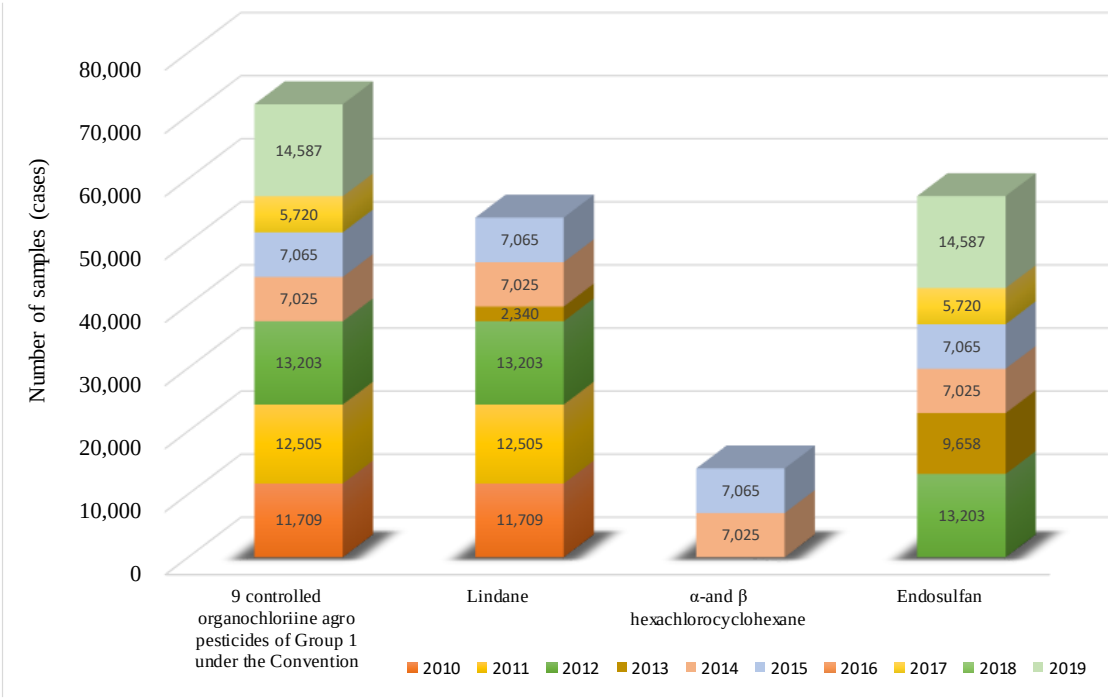


Figure 27 Number of Samples to analyze residual crops organochlorine agro pesticides in crops by COA over the years

B. Aquatic products

During 2013-2015, the Fisheries Agency of COA conducted testing of organochlorine agro pesticides in aquatic products from breeding environment and marker and found most were not detected for residual organochlorine agro pesticides. For details, see Table 26

C. Commercial foods

Since 2002, MOHW has focused on various foods (including commercially available fish and shellfish, dairy products and baby food, eggs and meat, edible fats and oils, commercially available cereals and

their products, fruits and vegetables and other agricultural products) to continue testing of organochlorine agro pesticides in 5,164 agricultural products and all were ND.

In the summary of 2002-2019 results（for the number of samples, see Figure 28）, only five of the 2002 samples of fish and shellfish were detected for DDT；and 4 of the 2005 samples of edible oils and fats were detected for DDT, among which 1 sample containedα-hexachlorocyclohexane and β- hexachlorocyclohexane and 3 samples contained Lindane；and 2 of the 2015 samples of imported flower teas were detected for DDT and Endosulfan over the limit, and 1 sample of domestic white fungus was detected for Endosulfan, and all the others complied with the domestic hygiene standards, and those over the limit were subject to regulatory action according to the Act Governing Food Safety and Sanitization.（the detection limits of organochlorine agro pesticides in related vegetables and fruits were all 0.01 ppm；and the limits for Mirex, Heptachlor, β- Endosulfan and Endosulfansulfate in cereals were 0.04 ppm, and the limits of the other agro pesticides were 0.02 ppm；and the limits of Aldrin and α- hexachlorocyclohexane in teas were 0.03 ppm, and the limit of DDT was 0.02, and the limits of β-Endosulfan and Endosulfansulfate were all 0.1 ppm, and the limits of the other agro pesticides were all 0.05 ppm）.

Table 26　Test results of organochlorine agro pesticides in aquatic products from breeding environment and market

Year	Sample	Tested substances	Test results
2013	• Aquatic products from 10 aquaculture ponds, pond water, sediments • 70 aquatic products from market	9 controlled organochlorine agro pesticides under the Convention	• Only 1 sample of cod from market was detected for hexachlorobenzene (3.8 ppb) and cochlordane (4.3 ppb), and 1 sample of salmon, 1 sample of barracuda and 1 sample of bonito were detected for DDT (1.4-78.4 ppb), and all the others were ND. • The detection limits of water body, sediments, and aquatic products were 0.1-2 ppb, 1-20 ppb, and 2-80 ppb, respectively.
		Lindane, α-hexachlorocyclohexane and β-hexachlorocyclohexane	• All were ND. • The detection limits of water body, sediments, and aquatic products were 2 ppb, 0.1 ppb, and 1 ppb, respectively.
		Pentachlorobenzene	• All were ND. • The detection limits of water body, sediments, and aquatic products were 2 ppb, 0.1 ppb, and 1 ppb, respectively.
		Endosulfan	• All were ND. • The detection limits of water body, sediments, and aquatic products were 2 ppb, 2 ppb, and 1 ppb, respectively.
2014	• Aquatic products from 15	9 controlled organochlorine agro pesticides under the	• Only one sample of imported sea cod (halibut) from market was detected for hexachlorobenzene (2.0 ppb), Chlordane (4.8 ppb) and DDT (3.0 ppb), and all the others were ND.

Year	Sample	Tested substances	Test results
	aquaculture ponds, pond water, sediments, and feeds. • 36 aquatic products from market	Convention	• The detection limits of aquatic products, water body, sediments, and aquatic feeds were 2-80 ppb, 0.1-2 ppb, 1-20 ppb, and 10-80 ppb, respectively.
		Lindane, α-hexachlorocyclohexane and β-hexachlorocyclohexane	• All were ND. • The detection limits of Lindane in aquatic products, water body, sediments, and aquatic feeds were 2 ppb, 0.1 ppb, 1 ppb, and 10 ppb, respectively.
		Endosulfan	• All were ND. • The detection limits of aquatic products, water body, sediments, and aquatic feeds were 2 ppb, 2 ppb, 1 ppb, and 10 ppb, respectively
2015	Aquatic products from 5 aquaculture ponds	9 controlled organochlorine agro pesticides under the Convention	• All were ND. • Except that the detection limit of Toxaphene was 80 ppb, all the others were 2 ppb.

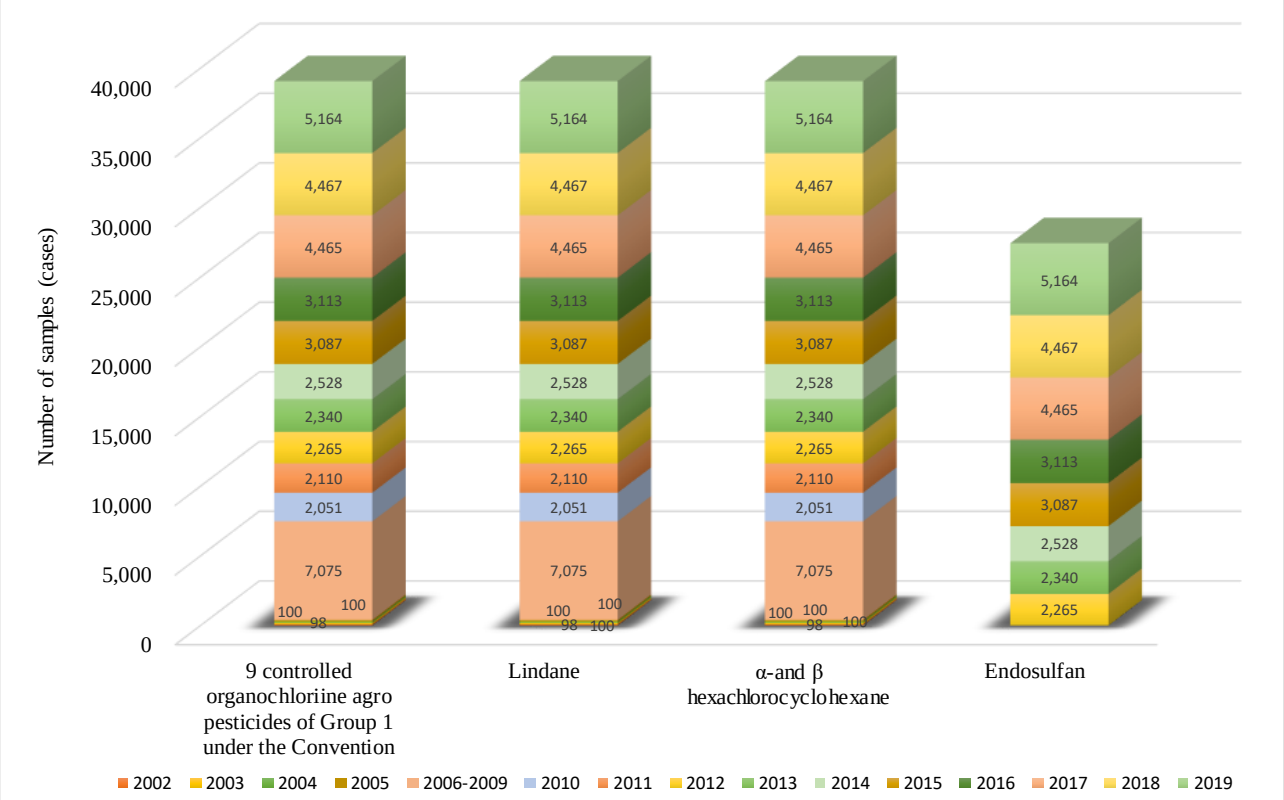


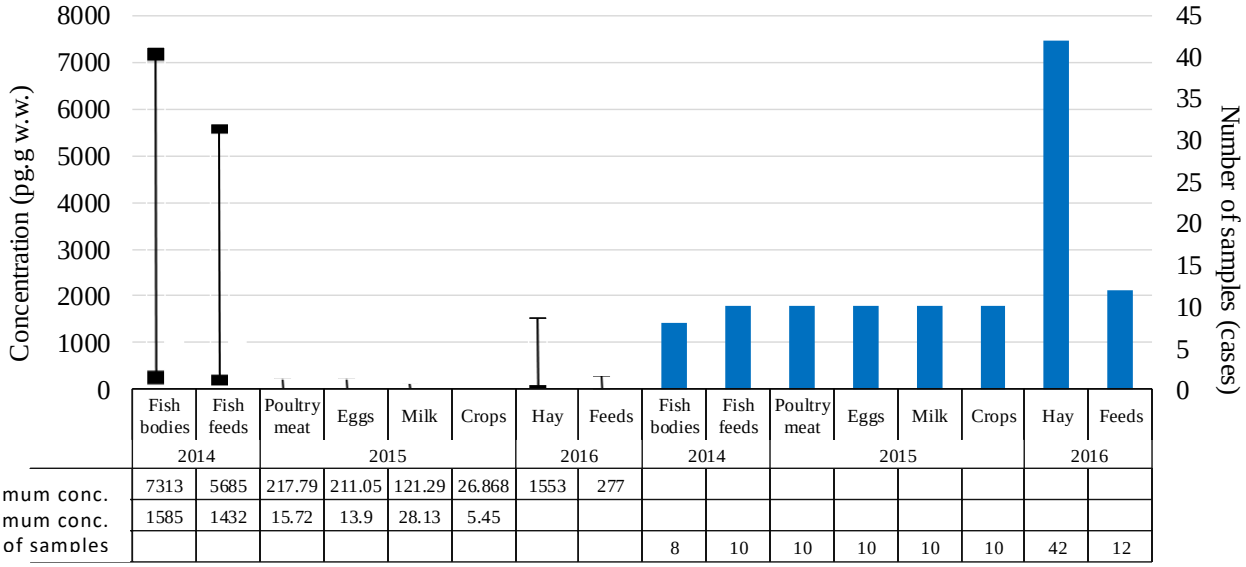
Figure 28 Number of samples to analyze residual organochlorine agro pesticides in market products by MOHW over the years

(II). Industrial chemical substances

A.Brominated flame retardant

(A) Polybrominated diphenyl ether

During 2014-2016, the Agricultural Chemicals and Toxic Substances Research Institute and the Agriculture and Food Agency of COA tested the contents of polybrominated diphenyl ether homologues in domestic crops, poultry, livestock, and fishery products. As shown in Figure 29, fish body had relatively higher content.



	Fish bodies	Fish feeds	Poultry meat	Eggs	Milk	Crops	Hay	Feeds	Fish bodies	Fish feeds	Poultry meat	Eggs	Milk	Crops	Hay	Feeds
	2014		2015				2016		2014		2015				2016	
Maximum conc.	7313	5685	217.79	211.05	121.29	26.868	1553	277								
Minimum conc.	1585	1432	15.72	13.9	28.13	5.45										
Number of samples									8	10	10	10	10	10	42	12

Note：In 2015, random testing of polybrominated diphenyl ether in crops from the surrounding farmland of 5 factories, including leaf sweet potato, pennisetum, lettuce, amaranth, water spinach, mustard greens.

Figure 29 Results of PBDEs in crops, poultry, livestocks and fishery products over the years

During 2006-2009, MOHW focused on 98 samples of dairy products, meat, fish, and shellfish products from market to conduct investigation of residual PBDEs. For detailed results, see Figure 30. Fish>meat>dairy products. During 2010-2013, MOHW continued to test residual PBDEs in 600 food products and found oils and fats products had the highest content, and among all food products, BDE-209 was the highest in PBDEs content distribution. For details, see Figure 31

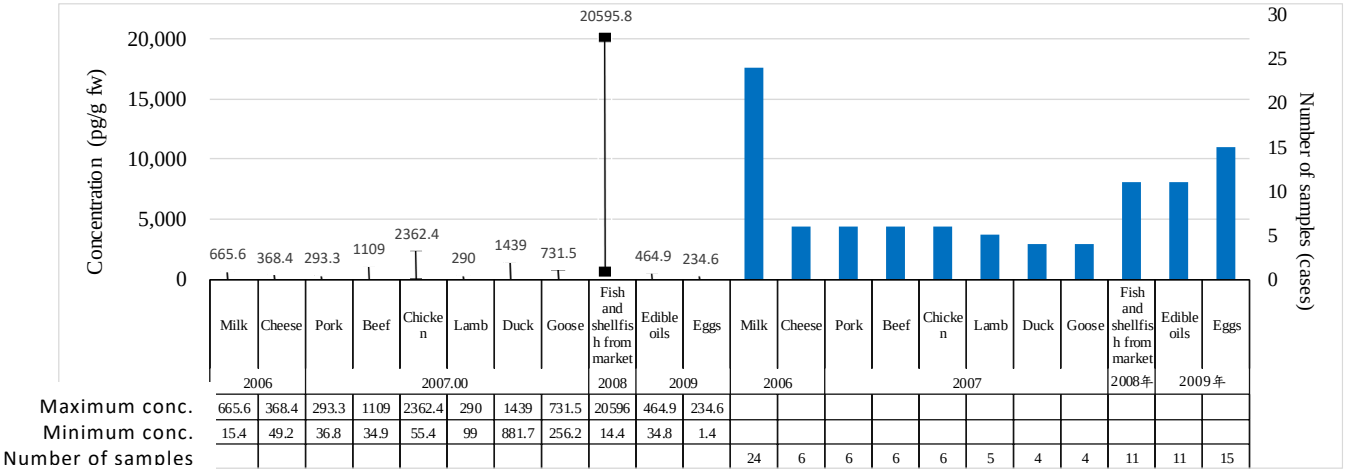


Figure 30 Results of contents of PBDEs in commercial food products tested by MOHW during 2006-2009

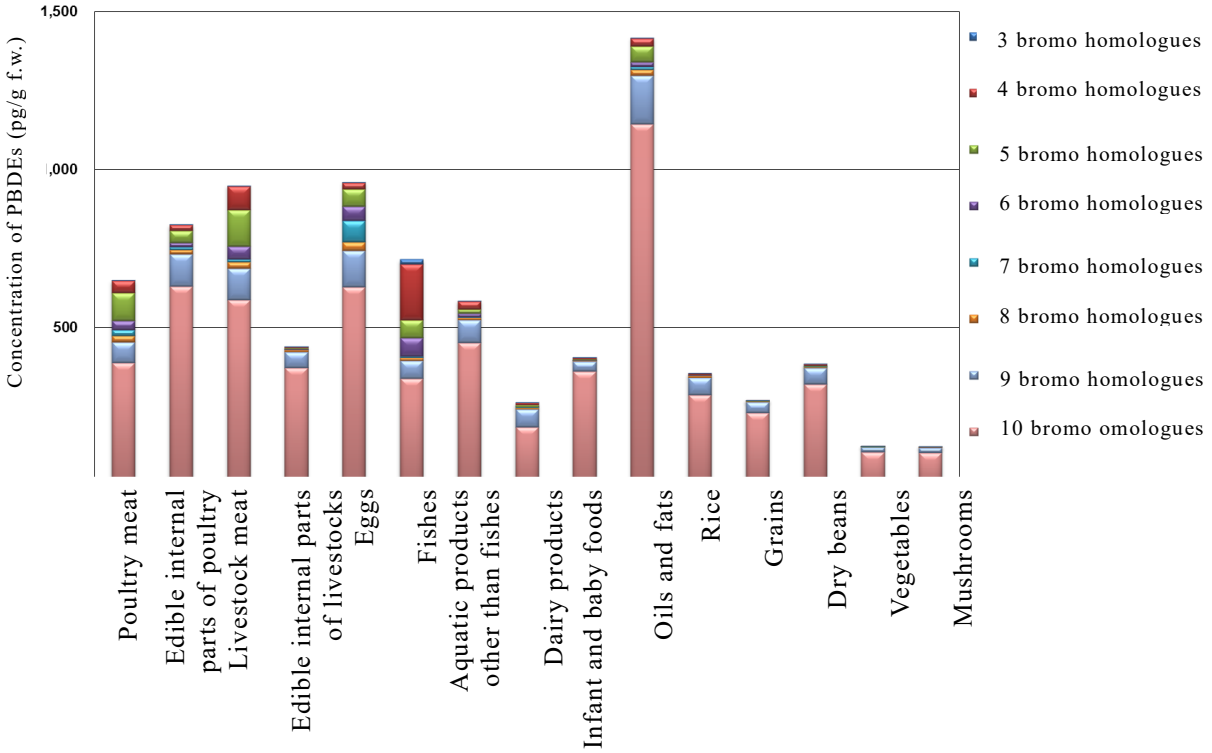


Figure 31 Average concentration and homologue distribution of PBDEs in various foods tested by MOHW during 2010-2013

Regarding commercial products, In 2016 and 2018, according to the CNS 15050「Electrical and electronic products- test method for six controlled substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ether)」, Ministry of Economic Affairs focused on the components of air purifier products of 3 brands, and「computer case」「hair blower」「extension power cord」 of 2 brands and 6 samples for each kind, to conduct testing of polybrominated diphenyl ether. For detailed results, see Table 27

Table 27 Status of testing polybrominated diphenyl ether in commercial products

	Kind of tested commercial product	Test result
2016	The components of air purifier products of 3 brands	1 Four plastic parts and modules from brand name air purifiers were tested to exceed the CNS 15663「Guidelines for reducing the content of restricted chemical substances in electrical and electronic equipment」that specifies the limit value 0.1% w/w for the polybrominated diphenyl ether mixture from heptabromine to decabromine, and it is mainly decabromodiphenyl ether, and three parts and modules were detected for 200 ppm 2, 2', 3, 4, 4', 5', 6-heptabromodiphenyl ether, and the detection limit was 25 ppm .
2018	「Computer case」「Hair blower」「Extension power cord」of 2 brands and 6 samples	5 samples were ND（detection limit0.01 %w/w）, 1 sample was detected for 0.017 %w/w decabromodiphenyl ether, and complied with the standards for CNS 15663 limit value 0.1% w/w.

(B) Hexabromobiphenyl

During 2012-2015, the Agriculture and Food Agency of COA collected 72 samples of crops, and all were detected for the substance. For example, in 2015, COA focused on the farmland near 5 factories operating with polybrominated diphenyl ether to randomly monitor the content of hexabromobiphenyl in 10 samples of crops（leaf sweet potato, pennisetum, lettuce, amaranth, water spinach, and mustard greens）, and the concentration range was 0.028-0.206 pg/g wet weight.

In 2013, MOHW analyzed the contents of 5 hexabromobiphenyl homologues, like HxBB-153, 154, 155, 156, 169, in 150 commercial food products, and the average wet weight concentration was 0.159-2.48 pg/g fresh weight.

(C) Hexabromocyclododecane

In 2014, COA completed the testing technology for hexabromocyclododecane homologues in crops. Later in 2015, COA focused on the farmland near 2 factories operating with hexabromocyclododecane to random monitor the total concentrations of hexabromocyclododecane (α-HBCD, β-HBCD, γ-HBCD) homologues in 10 samples of crops（purple lettuce, leek, leaf sweet potato, sweet potato, Chinese cabbage, pennisetum, and cauliflower etc.）, and the concentration range was 0.024-1.17 pg/g wet weight, which was close to the background concentration of

hexabromocyclododecane in total diet and vegetable and fruits in the United Kingdom of Great Britain.

In 2014, MOHW completed the investigation of content of hexabromocyclododecane in 270 commercial foods, and 44 samples (16%) were detected for HBCD homologues, and α-HBCD had the highest detection rate 15%, andγ-HBCD had the second highest detection rate 3%, and β-HBCD had the lowest detection rate 1%; by food type, marine fishes had the highest rate 69%, and shellfish had the second highest rate 63%, and terrestrial food had relative low detection rate（below 20%） for HBCD. The detection rate for total concentration of HBCDs in various foods was not over half, and all median values were ND value.

B. Perfluorinated compound（perfluorooctane sulfonic acid）

(A) Crops

In 2012, the Agriculture and Food Agency of COA collected samples of edible crops, like sweet potato leaves, garlic, cabbage, lettuce, and broccoli leaves, and all were not detected for perfluorooctane sulfonic acid. In 2013, COA tested perfluorooctane sulfonic acid in 2 samples of crops, like eggplant and convolvulus, and all were ND.

(B) Commercial foods

In 2011, MOHW conducted testing of perfluorooctane sulfonic acid in 52 food products from 4 types of foods, like aquatic products, meats, dairy products, and eggs, from Taipei City, Taichung City, Kaohsiung City and Hualiang County. For all four cities, milkfish had the highest concentration（Hualian County 19.3 ng/g, Kaohsiung City 12.2 ng/g, Taichung City 0.825 ng/g, and Taipei City 0.384 ng/g）, the concentration for all the other products were ND or fairly low.

C. Other industrial chemical substances

(A) Polychlorinated biphenyl

In 2019, the Fisheries Agency of COA implemented the 「Improve the quality and safety of aquatic products-monitoring of the production site of aquatic products before market」 project, and

tested dioxin and polychlorinated biphenyl in 54 samples. From 2017 to 2019, all testing results complied with foods hygiene standards. In addition. To comply with the EU's sanitary certification requirements for imported edible honey products, the Agriculture and Food Agency of COA implemented a honey product residue monitoring program. In 2019, COA continued random testing of 33 samples. During 2008-2019, all 267 honey products from random sampling were detected free of PCBs residues（detection limit：0.001 pg WHO_{2005}-TEQ/g f.w.）. For number of tests over the years, please see Figure 32

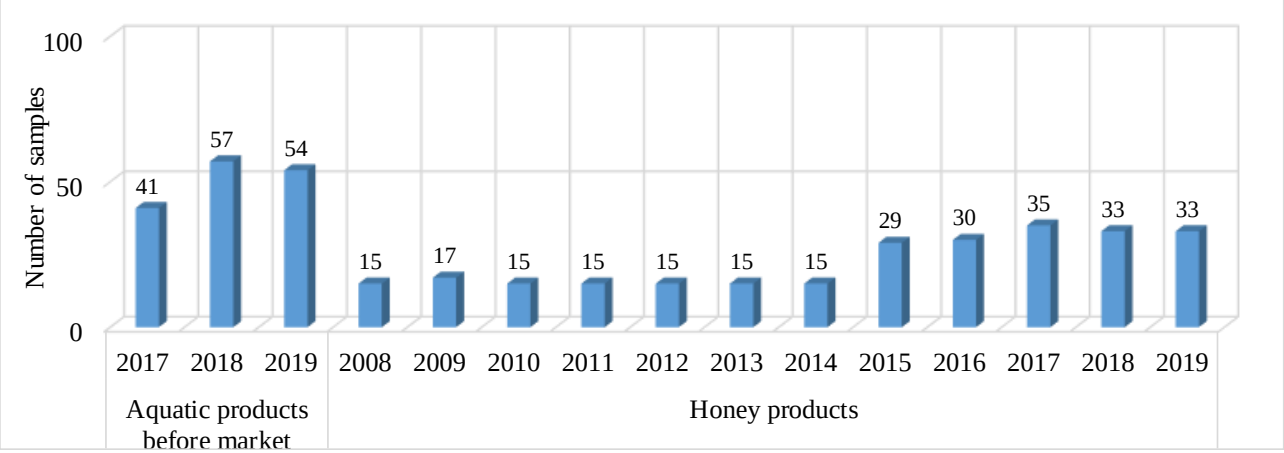


Figure 32　Number of tests of PCBs in aquatic products and honey products before market over the years

(B) Pentachlorophenoland its salts, esters

Currently there is no related domestic result for organism tests. For commercial products, during 2016-2019, according to CNS 14729「Test method for pentachlorophenol preservatives in wood」, the Bureau of Standards, Metrology and Inspection of MOEA tested the pentachlorophenol preservatives in wood panel products from market, including composite wood flooring, laminated veneer lumber, general plywood, medium density fiberboard, and decorative glulam（20 samples/ year）, and all were not detected for pentachlorophenol and pentachlorophenol sodium（all method detection limits were 0.1 kg/m^3）.

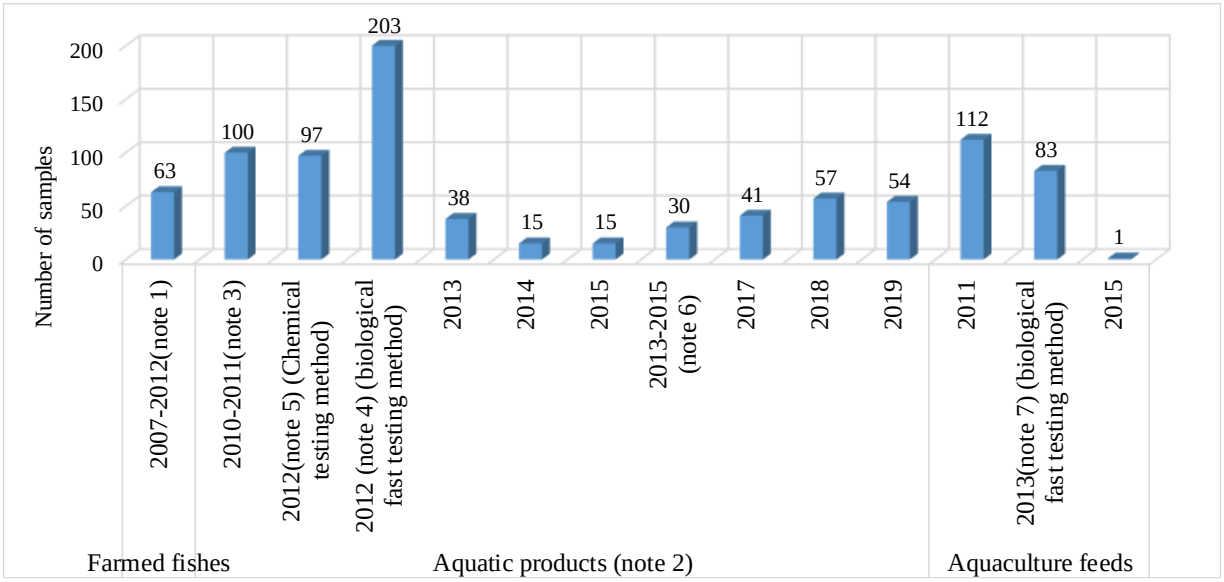
(III). Unintentional derivatives - dioxin and furan

A. Aquatic products and aquaculture feed

In 2019, the Fisheries Agency of COA implemented「Improve the quality and safety of aquatic products-monitoring of the production site

of aquatic products before market」project, and tested dioxin and polychlorinated biphenyl in 54 samples. All test results complied with the food hygiene standards.

All the test results of dioxin and furan in farmed fishes, aquaculture feeds and aquatic products before market tested by the Fisheries Agency of COA during 2007-2019 complied with domestic or EU control standards. For related testing status, see Figure 33



Notes：

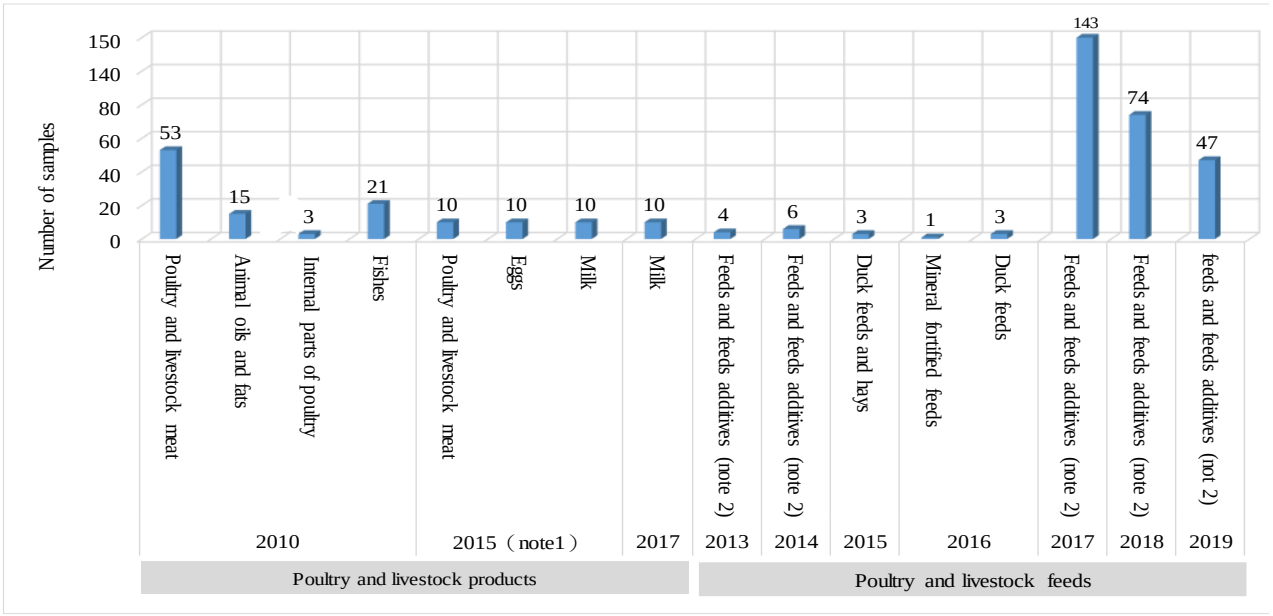
1. During 2007-2012, farmed fishes included 6-8 farmed fish products like Taiwan sea bream.
2. During 2010-2012, aquatic products included cultured aquatic products and offshore, offshore, and imported aquatic products.
3.During 2010-2011, the toxic equivalent concentration range for dioxin and furan in fishes and shellfishes was 0.022-0.503 pg WHO1998-TEQ/g fresh weight.
4. In 2012, biological fast testing method for dioxin compounds (DR CALUX® bioassay) was adopted to analyze 18 aquatic products (including fishes, double shellfishes and shrimps, and the result indicated that the content of dioxin compounds in aquaculture products（17 dioxin/ furan compounds and 12 dioxin polychlorinated biphenyl compounds）was 0.29 ± 0.31 pg DR CALUXTEQ/g wet weight, and the dioxin compound content for most samples was below 1.0 pg DR CALUX-TEQ/g wet weight；the dioxin compound content for ocean, offshore and imported aquatic products was 1.00 ± 1.55 pg DR CALUX-TEQ/g wet weight, and samples of bonito fish, salmon fish, saury fish, mackerel fish, and autumn sword fish had dioxin content higher than others, and the content in all samples was below EU formulated aquatic product limit 8.0 pg WHO-TEQ/g product.
5.In 2012, chemical testing method was adopted to analyze the total toxic equivalent concentration of dioxin and furan in fishes and shellfishes, and the results were below domestic and EU control standards.
6.During 2013-2015, according to the hygiene and quality monitoring plan for imported aquatic products implemented by European Commission Regulation 1883/12006（dioxin substances）, the dioxin content was below EU specified 4 pg WHO-TEQ/g.
7. In 2013, the biological fast testing method for dioxin (DR CALUX®) was adopted to analyze aquatic feeds, and the total toxic equivalent concentration of dioxin compounds was below 1.69 pg DR CALUX-TEQ/g product, and all were below EU formulated toxic equivalent limit for dioxin compounds in fish feeds 5.5 pg WHO-PCDD/F-PCB-TEQ/g product, and further HPGC-MS was used to quantitatively analyze 60 samples of feeds, and the results indicated the highest toxic equivalent concentration was still below EU maximum limit.

Figure 33 Testing of dioxin and furan in aquatic products and aquaculture feeds over the years

B. Poultry and livestock products and feeds

In 2019, the Department of Animal Industry of COA focused on poultry and livestock products and feeds to conduct testing of dioxin and dioxin type polychlorinated biphenyl, to strengthen health and safety management for livestock products and feed production, and monitored 47 samples of feeds and feeds additives, and the results for all samples were below domestic control limit for dioxin, furan and dioxin type polychlorinated biphenyl in feeds.

The results of dioxin and furan content (WHO_{2005}) in poultry and livestock products and feeds during 2010-2019 were all below domestic and EU control limits. For related testing status, see Figure 34



Notes：

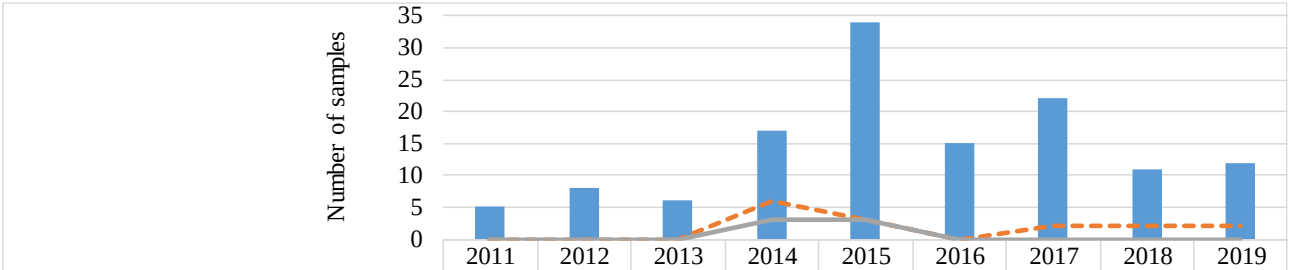
1. In 2015, the equivalent concentrations of dioxin furan in poultry and livestock meat, eggs and milk were from 0.220 to 0.909 pg WHO-TEQ /g fat, from 0.230 to 1.514 pg WHO-TEQ /g fat, and from 0.256 to 1.337pg WHO-TEQ /g fat, respectively. The equivalent concentrations of dioxin and dioxin PCBs were from 0.044 to 0.909 pg WHO-TEQ/g fat, from 0.059 to 0.274 pg WHO-TEQ/g fat, and from 0.145 to 0.845 pg WHO-TEQ/g fat, respectively.
2. Feeds and feeds additives include layer feed, fish meal, minerals, oyster shell powder, distiller grains and feed fats.
3.Poultry and livestock（pigs, chickens, ducks, lactating cows）feeds include forage grass, hay, agricultural by-products, mineral supplementary feed and feed additives；poultry and livestock products include poultry and livestock meat, animal oils and fats, internal parts of poultry, fishes, eggs, and milk.

Figure 34　Testing status of dioxin and furan in poultry and livestock products and feeds over the years

C. Crops

Since 2011, the Agriculture and Food Agency of COA monitored the total toxic equivalent concentrations of dioxin and dioxin type polychlorinated biphenyl in field crops, and according to monitoring by environmental agencies over the years, the data of emission pipelines

(chimney) of dioxin emission non-conforming factories and other high pollution potential factories were found, and EPA focused the crops in neighboring farmland to conduct sampling and testing of dioxin and dioxin type polychlorinated biphenyl contents. The monitoring and control status by years is shown in Figure 35 Among all, in 2019, 12 samples of crops were collected, and the dioxin of 2 samples exceeded EU fruit and vegetable action control value (0.3 pg WHO_{2005}-TEQ/g f.w.), and they were subject to regulatory action and control by local government, and the content range for dioxin type polychlorinated biphenyl was 0.006-0.0634 pg WHO_{2005}-TEQ/g f.w, not exceeding EU crops action control value.



	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of Samples	5	8	6	17	34	15	22	11	12
Number of dioxin non-conforming samples	0	0	0	6	3	0	2	2	2
Number of dioxin PCBs non-conforming samples	0	0	0	3	3	0	0	0	0

Notes：In *2014, non-conforming corps included 5 samples of leaf sweet potato and 1 sample of white bamboo shoots for dioxin, and 5 samples of leaf sweet potato for dioxin type polychlorinated biphenyl. In *2015, non-conforming corps included 1 sample of nightshade, 1 sample of pennisetum, and 1 sample of jasmine leaf for dioxin, and 1 sample of nightshade, 1 sample of pennisetum, and 1 sample of pumpkin leaf for dioxin type polychlorinated biphenyl. In *2017, non-conforming corps included 1 sample of leek and 1 sample of amaranth for dioxin. In *2018, non-conforming corps included 1 sample of leek and 1 sample of lettuce for dioxin. In *2019, non-conforming corps included 1 sample of corn and 1 sample of leaf sweet potato for dioxin. *EU cereals and oil containing seeds action control value： dioxin 0.5 pg WHO_{2005}-TEQ/g f.w. dioxin type polychlorinated biphenyl 0.3 pg WHO_{2005}-TEQ/g f.w. * EU fruit and vegetable action control value：dioxin 0.3 pg WHO_{2005}-TEQ/g f.w. dioxin type polychlorinated biphenyl 0.1 pg WHO_{2005}-TEQ/g f.w.
*Monitored field crops included rice, cabbage, corn, groundnut, guava, tomato, leaf sweet potato, spring onion, basil, pumpkin, water chestnut, chrysanthemum, onion, cabbage, celery, leek, lettuce, water spinach, red amaranth, nightshade, pennisetum and add jasmine.

Figure 35 Testing status of dioxin, furan and dioxin type polychlorinated biphenyl in crops over the years

D. Commercial foods

During 2008-2012, to understand whether dioxin is potential health hazard to domestic people, MOHW conducted investigation of background values of dioxin and dioxin type polychlorinated biphenyl in foods year by year, and completed testing of 865 samples of meat products, processed meat products, fishes and shellfishes, processed fish

and shellfish products, dairy products, eggs, cereals and processed cereal products and vegetables, and all results complied with domestic regulations.

Since 2013, it has been planned to establish the contents of dioxin and furan and dioxin type polychlorinated biphenyl in foods (including cereals, oils and fats, aquatic products, dairy products, poultry and livestock products, eggs, and fruits and vegetables) from seven domestic areas（North, Hsinchu Miaoli, Central, Yunlin Jiayi Tainan, Kaohsiung and Pingdong, east Hualian area, Yilan and outlying island area）. In the summary of the results of contents of dioxin and furan in foods from various domestic areas from 2013 to 2019, except that 1 sample of eff in 2017 exceeded the domestic standard, which immediately initiated the「MOHWCOA EPA environmental protection food safety reporting and emergency responsive measure process」 and started further action, all other samples complied with domestic「Management regulations for foods containing dioxin and polychlorinated biphenyl」. For details, see Figure 36

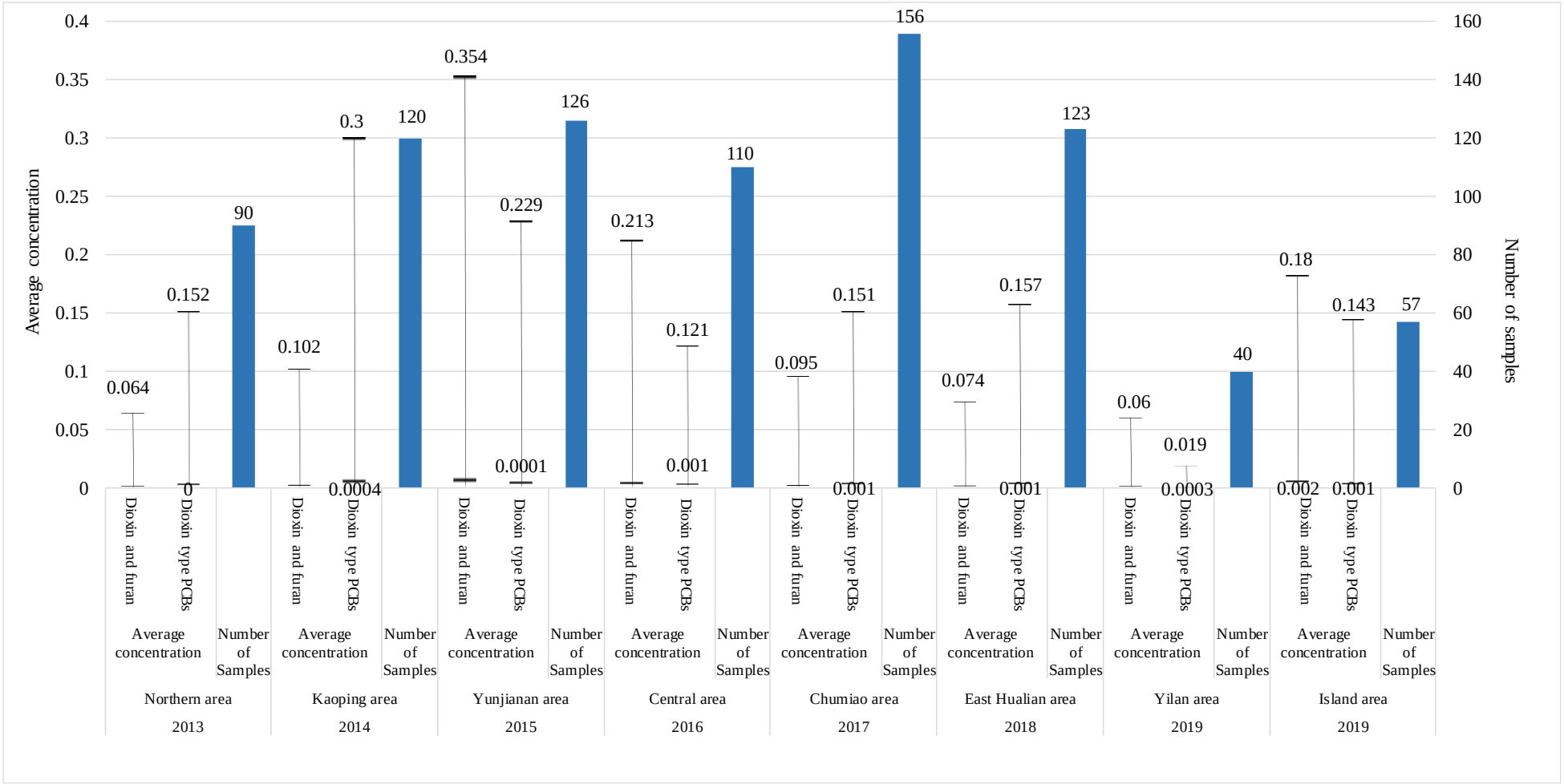


Figure 36 Results of contents dioxin and furan in foods from various domestic areas

(IV). Conclusions

In 2019, the testing results for organism and commercial products are summarized as follows：

A. COA results

(A) Crops: 14,587 samples of crops of rice, vegetables and fruits were tested, and except 1 sample of pumpkin was found for Dieldrin （the edible crops on the ground have been eradicated and destroyed, but have not been introduced into the market）, the others were not found for any convention controlled organochlorine agro pesticides（detection limit：0.01ppm） or complied with food safety and hygiene regulations. Besides, according to the historical monitoring by the environment protection agencies, and the factory data regarding the emission pipelines (chimney) from dioxin emission nonconforming plants and other factories of high pollution potential, sampling of crops was conducted on adjacent farmlands, and in 2019, 12 samples of crops were tested for dioxin and dioxin type polychlorinated biphenyl contents, and 2 samples in the results exceeded the dioxin EU fruit and vegetable action control value (0.3 pg WHO_{2005}-TEQ/g f.w.), and they were disposed and controlled by local governments, and the content of dioxin type polychlorinated biphenyl was 0.006-0.0634 pg WHO_{2005}-TEQ/g f.w, not exceeding crops action control value.

(B) Feeds and feeds additives：Testing of 47 samples of feeds and feeds samples was conducted and found the detected values of all samples were below domestic control values of dioxin, furan, and polychlorinated biphenyl in feeds.

(C) Edible honey products：To comply with EU requirement of health certification, 33 samples were tested and found no residual PCBs.

(D) Aquatic products: 54 samples of aquatic products were tested for dioxin and polychlorinated biphenyl, and all complied with the heath standard.

B. MOHW results

(A) Commercial agricultural products: 5,164 samples of commercial agricultural products were tested, and all were not found for the residual agro pesticides in the first group such as organochlorine agro pesticides, α- hexachlorocyclohexane, β- hexachlorocyclohexane, Lindane, and Endosulfan, and all met the domestic health standard.

(B) Commercial foods：The analysis of contents of dioxin, furan and dioxin type polychlorinated biphenyl in 97 samples of commercial foods from Yilan and outlying islands was tested, and the weight average concentration ranges of dioxin and furan in various kinds of foods were 0.002-0.06 and 0.002-0.18 pg WHO_{05}-$TEQ_{PCDD/F}$/g fresh weight, and the average concentration ranges of dioxin type polychlorinated biphenyl were 0.0003-0.019 and 0.001-0.143 pg WHO_{05}-TEQ_{PCB}/g fresh weight respectively, and all samples complied with domestic「Management Regulations for Foods Containing Dioxin and Polychlorinated Biphenyl」.

C. Ministry of Economic Affairs：According to CNS 14729「Test method for pentachlorophenol preservatives in wood」, 20 samples of wood products from market were tested, including composite wood flooring, laminated veneer lumber, general plywood, medium density fiberboard, and decorative glulam, for pentachlorophenol type preservatives, and all 20 samples were not detected for any pentachlorophenol and pentachlorophenol sodium（all method detection limits were 0.1 kg/m^3）.

V. Other implementation results

(I). Results of domestic emission (release) reduction of dioxin and furan

Since 2001, EPA has estimated the domestic emission of dioxin into air and established and updated the emission inventory every year. If the data of 2002 are used as the basis, the total emission of dioxin into atmosphere was estimated 327.5 g I-TEQ. During 2003-2010, with small and medium incinerators, electric arc furnaces in the steel industry, and sintering plants in the steel industry, and implementation of the second stage emission standards for the existing electric arc furnaces in 2007 and the second stage emission standards for the sintering furnaces in 2008, the emission has decreased over the years. As of 2018, the total

emission of dioxin into atmosphere has been reduced to 51.01 g I-TEQ, which compared to that in 2002 the total reduction rate was 84%, and the reduction result was excellent. For details, see Table 28 and Figure 36

(II). Domestic risk assessment results

A. Estimation of life-time adult average daily dose of dioxin, furan, and dioxin type polychlorinated biphenyl

In 2019, MOHW through National Food Consumption Database obtained the food intake and body weight data for each age group from the second level in north (Taoyuan City, Hsinchu Country (City) and Yilan County) and the level in south (Jiayi County (City), Tainan City, Kaohsiung City, Pingdong County and Penghu County) , and with the toxic equivalent concentration information of dioxin compounds in various foods from Yilan and outlying islands investigated in 2019, estimated the average daily dose (ADD) for all age groups from Yilan and outlying island area , and according to the average daily dose, estimated the life-time average daily dose (LADD) as 0.108, 0.344 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day, respectively（life-time average weekly doses were 0.759 , 2.406 pg WHO$TEQ_{PCDD/F+PCB}$/kg BW/week, respectively）, compliant with WHO tolerable daily intake (TDI) 1～4 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day and the European Food Safety Authority (EFSA) tolerable weekly intake (TWI) suggested value 2 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/week.

From 2013 to 2019, MOHW completed the estimation of exposure risk of dioxin/ furan and dioxin type polychlorinated biphenyl through food intake for the people from various areas, and the life-time average daily dose range was 0.108~ 0.433 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day（Figure 37）, all compliant with WHO TDI 1-4 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day, which indicates in recent years our country has achieved remarkable results in the source control of polychlorinated dioxin/furan and dioxin polychlorinated biphenyl.

Table 28 Emission and reduction of dioxin during 2002-2018

year / emission source type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Garbage incineration (including large scale and medium and small)	12.44	8.14	3.27	2.10	1.36	4.71	4.40	4.01	3.78	4.05	4.09	3.98	4.11	4.70	5.05	5.33	5.34
Industrial waste incinerator	51.20	26.97	0.66	1.32	0.85	1.36	1.44	1.05	0.67	0.31	0.47	0.35	0.38	0.49	0.51	0.32	0.38
Electric arc furnace for steelmaking industry	178.79	117.45	25.02	32.04	42.04	17.68	12.95	10.92	13.87	13.21	8.17	7.60	6.44	6.02	5.73	6.14	7.29
Sintering furnace	37.25	28.18	28.14	5.76	20.07	22.97	10.38	6.24	9.54	9.84	8.67	8.08	10.60	7.83	5.78	7.67	6.18
Dust ash collection high-temperature smelting facility	20.70	31.15	67.28	39.39	1.10	0.13	0.19	0.10	0.93	0.19	0.18	0.12	0.15	0.27	0.29	0.13	0.14
Secondary smelting of copper, aluminum, zinc, and lead	5.47	3.61	3.95	4.62	2.04	4.62	5.61	4.54	3.27	3.62	2.86	2.58	3.06	2.19	1.68	1.48	2.13
Boiler combustion (coal, fuel oil, black liquid recovery)	5.11	5.39	5.94	6.64	8.89	13.19	13.82	14.16	14.29	12.33	9.89	12.67	10.28	11.97	12.88	12.80	12.87
Unable to control the source of combustion (fire, open burning)	7.65	5.73	5.13	5.07	5.30	4.57	4.04	6.24	5.60	6.40	11.51	10.96	12.85	13.43	13.62	11.68	10.38
Mobile source emission	2.07	2.15	2.23	2.14	2.11	2.15	2.01	2.30	2.38	2.38	2.36	2.36	2.66	2.26	2.26	2.26	2.42
Other	6.69	6.67	5.83	3.38	4.91	3.74	3.78	3.31	3.49	3.40	3.16	3.95	4.12	4.71	4.32	3.85	3.89
Total emission	327.4	235.4	147.4	102.5	88.7	75.1	58.6	52.9	57.8	55.7	51.4	52.65	54.65	53.86	52.12	51.67	51.01
Reduction rate		28.1%	55.0%	68.7%	72.9%	77.1%	82.1%	83.8%	82.3%	83.0%	84.3%	84%	83.3%	84%	84%	84%	84%

Note1：unit g I-TEQ/year.

Note2：2002 is the base year, reduction rate ＝（actual emission－actual emission in the base year）÷（actual emission in the base year）×100%.

Note3：After 2007, garbage incineration is added to the estimation of emission by starting and stopping large incinerator, so its emission is higher than that of 2006.

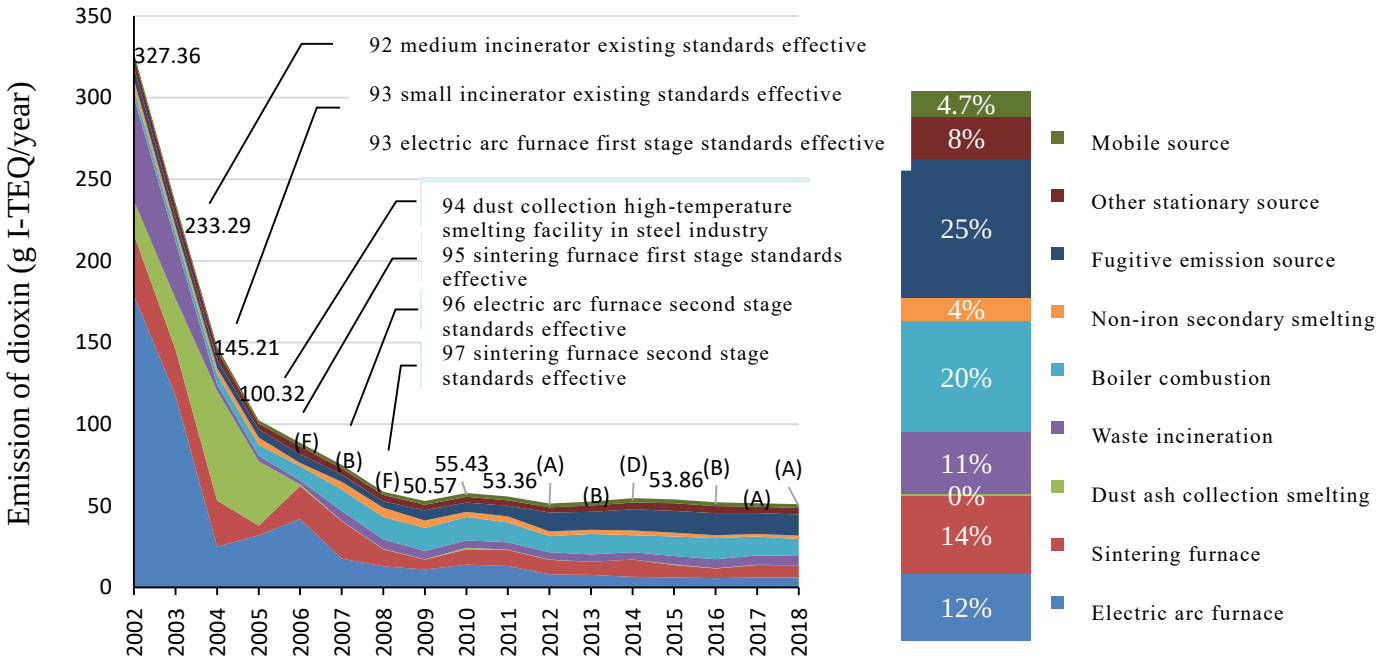


Figure 36 Decreasing trend in emission of dioxin during 2002-2018

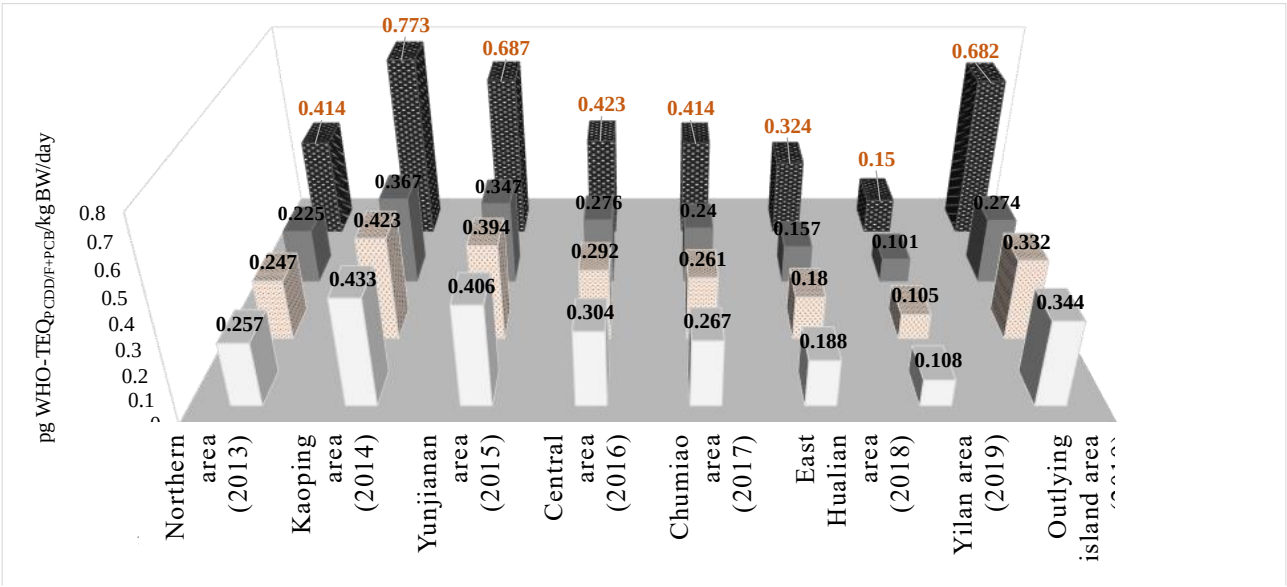


Figure 37 Estimation of exposure dose of dioxin/ furan and dioxin type polychlorinated biphenyl through food intake for the people from various areas during 2013-2019

B.Investigation and risk assessment for dioxin, furan, and dioxin type polychlorinated biphenyl in blood of domestic people

During 2008-2012, MOHW focused on the age group of 18-65 years from various areas in Taiwan (Taipei, Hsinchu, Taichung, Tainan, Kaohsiung, and Hualian) to investigate the background values of dioxin, furan and dioxin type polychlorinated biphenyl in blood, and showed the median concentration of 17 kinds of polychlorinated dioxin/furan

was 8.67-13.9 pg WHO_{1998}-$TEQ_{PCDD/F}$/g lipid, and the median concentration of 12 kinds of dioxin type polychlorinated biphenyl was 4.16-8.63 pg WHO_{1998}-TEQ_{PCB}/g lipid, which compared with the concentration of dioxin compounds in the blood of residents of other countries, it was not higher.

In 2013, MOHW continued to establish the background values of dioxin, furan and dioxin type polychlorinated biphenyl in blood of the age groups of 18-65 years from Taipei and Keelong air quality area (30 samples), and the median concentration of 17 kinds of polychlorinated dioxin/furan in blood and the median concentration of 12 kinds of dioxin type polychlorinated biphenyl in blood were 7.31 pg WHO_{2005}-TEQ_{DF}/g lipid and 2.64 pg WHO_{2005}-TEQ_{PCB}/g lipid, respectively. For details, see Table 29

Table 29 Background values of dioxin in blood of people in Taiwan

Area	median concentration of 17 kinds of dioxin/furan (note1)	median concentration of 12 kinds of dioxin type polychlorinated biphenyl (note2)
Hsinchu, Taichung and Kaohsiung area (2008)	13.9	8.63
Southern area (2009)	9.18	6.31
Northern area (2010)	10.7	4.16
Central area (Taichung City) (2011)	11.4	4.16
Hualian County and City (2012)	8.67	4.28
Taipei and Keelong air quality area (2013)	7.31	2.64

Note 1：Concentration of 17 kinds of polychlorinated dioxin/furan, during 2008-2012, the unit was pg WHO_{1998}-$TEQ_{PCDD/F}$/g lipid, in 2013 pg, WHO_{2005}-$TEQ_{PCDD/F}$/g lipid.

Note2：Concentration of 12 kinds of dioxin type polychlorinated biphenyl, during 2008-2012, the unit was pg WHO_{1998}-TEQ_{PCB}/g lipid, in 2013, pg WHO_{2005}-TEQ_{PCB}/g lipid.

C. Health risk assessment of polychlorinated biphenyl for domestic people

In 2015, according to the investigation results of background values of polychlorinated biphenyl content in domestic food products, MOHW conducted health risk assessment, and the exposure doses of 95 percentile value from all age groups were all lower than ICES-6 TDI reference value, 10 ng/kg/day, set by Holland, France and Norway in Europe, so the Hazard Index (HI) was below 1, between 0.25-0.72, within acceptable range, indicating that the current NDL-PCBs through food intake by domestic people will not cause health hazards.

D. Estimation of life-time average daily dose of polybrominated diphenyl ether for domestic people

According to the domestic data of contents of 24 kinds of

polybrominated diphenyl ether homologues in 600 various kinds of foods established during 2010-2013 and the daily food intake of all age groups from National Food Consumption Database, MOHW estimated the average daily dose (ADD) of polybrominated diphenyl ether for all age groups, and the result indicated that the average daily dose for all age groups was far lower than the reference value 100 μg/kg bw/day used in the risk assessment of polybrominated diphenyl ether by the Joint FAO/WHO expert committee on food additives (JECFA), and the exposure dose of polybrominated diphenyl ether at 95 percentile for all age groups estimated by Monte Carlo simulation was also far below the reference value.

E. Estimation of life-time average daily dose of perfluorooctane sulfonic acid for domestic people

In 2011, MOHW tested food products and conducted exposure risk assessment with milkfish, which had the highest concentration (19.3 ng/g) , for domestic age groups of 19-64 years, and obtained the estimated dose of perfluorooctane sulfonic acid as 3.8 ng/kg/day, which was still far below the EU standard 60-200 ng/kg/day.

F. Estimation of life-time average daily dose of hexabromobiphenyl for domestic people

In 2013, according to the established data of contents of 5 kinds of HxBBs homologues from 150 kinds of food products and the daily food intake of all age groups from National Food Consumption Database, MOHW estimated the average daily dose of HxBBs for all age groups and all were far below the no-observed effect level (NOEL), 0.15 mg/kg bw, used by EFSA to conduct risk assessment of polybrominated biphenyl (PBBs), and the exposure dose of HxBB at 95 percentile for all age groups estimated by Monte Carlo simulation was also far below NOEL.

G. Exposure limit of hexabromocyclododecane for domestic people

In 2014, according to the investigation results of background values of hexabromocyclododecane contents in domestic food products, MOHW conducted health risk assessment. With reference to the exposure limit of hexabromocyclododecane estimated by the food chain

contamination expert team in EFSA, the estimated dose at 95 percentile for all age groups was 959-3690, and the exposure limit was larger than 100, indicating presently the exposure to HBCD from dietary sources for domestic people will not cause health problems, and the exposure to hexabromocyclododecane through food is far below the acceptable risk.

(III). Management of polluted sites

In 2019, EPA did not have new notice of newly added polychlorinated biphenyl or dioxin or notice of removed site.

(IV). Disposal status of waste containing POPs

The disposal of toxic chemical substances after being discarded should be handled according to the relevant laws and regulations of the“Waste Disposal Act". If the company that generates the waste is a business designated by EPA to declare the waste cleanup and flow route through the Internet, it should follow the online reporting operating procedure by EPA.

According to the "Hazardous industrial waste identification standards", toxic and hazardous industrial waste includes: (1) solid or liquid waste of toxic chemical substances of Class 1, Class 2 and Class 3 publicized according to the Toxic and Concerned Chemical Substances Control Act, (2) Discarded containers of direct contact with toxic chemicals；dioxin hazardous industrial waste：refers to the total toxic equivalent concentration of 17 kinds of compounds exceeding 1.0ng I-TEQ/g, including 2, 3, 7, 8-chlorinated dioxin and furan homologues in industrial waste；polychlorinated biphenyl hazardous industrial waste refers to waste capacitors (calculated by the weight of insulating oil), waste transformers (calculated by the weight of transformer oil) or other industrial wastes with a polychlorinated biphenyl content of more than 50 ppm by weight. The storage, removal, and disposal of the hazardous industrial waste should be handled according to the corresponding regulations of the "Methods and Facilities Standards for the Storage, Clearance and Disposal of Industrial Waste and Facilities Standard". In addition, the company should select the appropriate waste code in the industrial waste disposal plan to indicate the storage, removal, treatment method and quantity of such waste, and should entrust the public and private organization with waste disposal permit for removal and treatment of such hazardous industrial waste. Regarding the disposal and storage quantity of wastes containing POPs in 2019, see Table 30.

POPs	Type of waste contaminated by POPs		Disposal route reported in 2019 (ton)				Total (ton)	Storage quantity in 2019 (ton)
			Reuse	Self-disposal	Commissioned or joint disposal	Overseas disposal		
9 organochlorine agro pesticides in the first controlled group	Wastes contaminated by the 9 organochlorine agro pesticides in the first controlled group		-					
polychlorinated biphenyl in the first controlled group	polychlorinated biphenyl hazardous industrial waste	Waste transformer (based on transformer oil weight） containing polychlorinated biphenyl above 50 ppm (C-0802)	--	--	--	--	--	--
		Waste transformers, waste capacitors with weight content of polychlorinated biphenyl less than 50 ppm and containing grease (E-0207)	--	--	8, 875.33	--	8, 875.33	1, 756.46
	polychlorinated biphenyl hazardous industrial waste	Waste transformers, waste capacitors with weight content of polychlorinated biphenyl less than 50 ppm and no grease (D-2507)	--	20.36	757.41	64.90	461.31	216.61
dioxin and furan in the first controlled group	2, 3, 7, 8- chlorinated dioxin and furan homologues (C-0120)		-	--	200.16	--	200.16	233.04
second group of POPs under the Convention-α-hexachlorocyclohexane, β- hexachlorocyclohexane, hexabromodiphenyl ether and heptabromodiphenyl ether, tetrabromodiphenyl ether and pentabromodiphenyl ether, chlordecone, hexabromobiphenyl, Lindane, pentachlorobenzene, perfluorooctane sulfonic acid and its salts type and perfluorooctane sulfonate fluoride			-					
third group of 1 POPs under the Convention- Endosulfan			-					
fourth group of 1 POPs under the Convention-hexabromocyclododecane			-					
fifth group of 3 POPs under the Convention- chlorinated naphthalene, hexachloro-1, 3-butadiene and pentachlorophenoland its salts and esters			-					

(V). Public education advocacy

A. EPA

In recent years, EPA has conducted「2008 Persistent organic pollutants（including dioxin）conference」,「From how people participate in the National Implementation Plan (NIP) to the implementation achievement of the Stockholm Convention Forum」,「Environmental hormones and persistent organic pollutants conference」,「Keep up with the international persistent organic pollutants control forum」,「Persistent organic pollutants control conference」 and 「Presentation of inter-ministerial implementation of environmental hormones, persistent organic pollutants and mercury management」, and completed the edition of「Handbook of Investigation Results of Environmental Distribution of Toxic Chemicals」(2009-2019), and provided the latest information and publish academic research results by inviting domestic and foreign experts, scholars and government to forum on print media and newspaper, to promote public awareness and understanding of POPs, and advocate the corresponding measures taken by the government.

Besides, the Toxic and Chemical Substances Bureau of EPA has implemented「Persistent Organic Pollutants Information website」(https://topic.epa.gov.tw/pops/mp-(B)html) and「Investigation Information of Environmental Distribution of Toxic Chemicals website」(https://topic.epa.gov.tw/tcd/mp-(G)html),to mainly convey information about our country's management of POPs hazards, international Convention, and the results of simultaneous control of POPs domestically and internationally, etc., and also produced 「Chemical Substances in Daily Life」 and implemented「Chem Life」Facebook page, to increase public understanding of POPs.

B. MOHW

In recent years, we have announced information and activities through news media and websites to enhance public awareness of government actions, the level of dioxin risks in diet and how to maintain food safety, and achieved the goal of public health education advocacy through health risk communication activities, and understood people’s

actual needs, provided individual consultations, and enhanced the independent health care ability for individuals through the implementation of residential health care plan.

Health Promotion Administration continued to care for the health of patients with oil disease (polychlorinated biphenyl contaminated rice bran oil incident in 1979), and conduct regular visits, and provide health education, health information, medical referral and consultation services for patients with oil disease.；and organize education and training for health care workers for patients with oil disease, and arrange courses related to understanding the effects of polychlorinated biphenyl and the disease；and use the "Handbook of Health Education for Patients with Oil Disease" to provide reference in health education for patients with oil disease and medical workers for caring visits. As of the end of December 2019, a total of 1,884 patients with oil disease were enrolled to receive services, and individual visits, care and consultation services have been provided regularly. HPA has held one session of education and training for health care workers of oily patients (all local government health agencies (institutes, health service centers), medical institutions, a total of 72 participants), and through professional education to improve knowledge of polychlorinated biphenyl poisoning for health care workers. A total of 7 health promotion activities for oily patients were held in Taichung and Chunghua area for oily patients (103 patients participated), providing free transportation, health check services, and health promotion seminars (such as environmental hormones, nutritional hygiene education, chronic disease prevention and care, health care with traditional Chinese medicine, health care medicated diet, nutrition supplements and other health knowledge).

C. COA

To reduce air pollution and dioxin hazards caused by open burning of agricultural wastes such as straw or fruit tree residues, COA continued to advocate for farmers to use straw, chopping and soil burying as the main treatment method, and the rest would be recycled and reused to provide materials such as bedding, covering materials, cultivation media, compost or fuelwood. Through the press releases,

electronic billboards and gatherings of farmers, farmers were encouraged to pick up rice straw and chop it for burying in the field and were promoted with the application of organic fertilizer containing straw decomposing bacteria.

D. Ministry of Economic Affairs

In view of the increasingly advanced and strict international environmental protection standards such as the EU RoHS Environmental Directive (Hazardous Substances Prohibition and Restriction), and REACH Act (Chemical Substance Information Transmission), etc., and to actively assist the industry in clean production and pollution improvement work, "Industrial Green Technology Information Website" was implemented (http://proj.ftis.org.tw/eta/), to provide different types of guidance on cleaner production, environmental protection technology and regulations for various industries, and assist various industries to effectively introduce cleaner production technology to improve environmental safety and build an industrial environment of sustainable resource recycling.

E. Occupational Safety and Health Administration of the Ministry of Labor

Occupational Safety and Health Administration of the Ministry of Labor, according to the authorities and responsibilities, established hazard identification information for high-hazard chemicals that may be exposed to workers, and continue to strengthen the advocacy of chemical hazards in the workplace. Presently, to protect workers' "right to know" about hazardous chemicals, according to the United Nations Globally harmonized system for classification and labelling of chemicals (GHS), the labeling of hazardous chemicals, examples of safety data sheet reference and related education and training tools have been established, and which was built on the GHS chemical coordination system website, to provide users with references (the website has more than 100,000 visits per month), website： http://ghs.osha.gov.tw/.

(VI). Results for addition and revision of standard test methods

In 2019, our country added and revised the following three test methods:

A. EPA revised the sampling method of dioxin and furan in water (NIEA W790.51B)(November 20, 2019, EPA test no. 1080006959 publication), which is applied to sampling of drinking water, drinking water source, surface water, groundwater and discharged water for testing of dioxin and furan (PCDDs/PCDFs).

B. EPA added testing method of polychlorinated naphthalene in environmental elements — isotope labeling dilution/gas chromatography/high resolution or tandem mass spectrometer (NIEA M908.00B)(December 18, 2019, EPA test no. 1081007880 publication), this method uses gas chromatography/high resolution mass spectrometer or gas chromatography/tandem mass spectrometer to analyze polychlorinated naphthalenes (PCNs) in samples from environment or other materials, and the sample is subject to extraction, concentration, and purification procedures, and the concentration of polychlorinated naphthalene homologues is determined by the 13C10-isotope dilution method (isotope dilution method).

C. May 10, 2019, MOHW publicized the revised「Test method of agro pesticides residues in food - multiple residue analysis method（E）」.

D. COA established the test method of residual dioxin and dioxin type polychlorinated biphenyl in hairy crabs（gas chromatography tandem mass spectrometry）, which was publicized by Food and Drug Administration of MOHW as suggested method.

E. The Bureau of Standards, Metrology and Inspection of the Ministry of Economic Affairs formulated CNS 18219「leather- determination of chlorinated hydrocarbons in leather － short-chain chlorinated paraffin (SCCP) chromatography」, including chromatography for the contents of C10~C13 short-chain chlorinated paraffin in treated or untreated leather.

(VII). R&D and assistance for alternative products or processes

The environmentally friendly fluorine-free water repellent independently developed by the Textile Research Institute does not contain perfluorocarbon octyl (PFOS/PFOA) compounds. The product is currently promoted to the textile industry for finished fabric treatment and replace fluorine-containing water repellent. Presently, Textile Research Institute continued to assist the

industry in investing into production of textile additives and applications; besides, to meet the industrial needs, to produce custom products of fluorine-free water repellent（model：WR28）, and accelerate the deepening development of substitutes by expanding the industrial scale of fluorine-free products, and continue to work towards the goal of zero-fluorocarbons (PFCs) in the industrial process chain.

VI. Conclusions

The control of POPs in our country has been fully managed through source control, monitoring of environmental media and organism, establishing product standards, regulatory audits, encouraging industries to use alternatives with less environmental impact and educational advocacy. Presently, with focus on the controlled POPs substances under the Convention（except dioxin and furan）, the“Toxic Chemicals and Concerned Substances Management Act" or "Agro-Pesticides Management Act" has been implemented to control the operation. As for dioxin and furan, which are mainly from the combustion by-products of industrial processes, there are also control standards and regulations under the relevant pollution prevention and environmental protection regulations.

Relevant monitoring and testing results can show that Taiwan has been quite effective in POPs control. For example, the first group of controlled POPs under the Convention have been banned domestically for many years, their environmental concentrations are low or lower than the detection limit. According to the investigation of domestic diets, the life-time average daily doses or exposure limits for dioxin, furan, dioxin type polychlorinated biphenyl, polybrominated diphenyl ether, perfluorooctane sulfonic acid, hexabromobiphenyl and hexabromocyclododecane all complied with foreign country recommended standard value or reference dose.

With increasing income and environmental protection awareness, the requirements for environmental quality are also increasingly strict. To protect people’s health and prevent their living environment from being harmed by persistent organic pollutants, our country will continue to pay attention to the latest development of POPs Convention, and continue to promote source control, emission reduction, and control and research and development for alternative technology for persistent organic pollutants through inter-ministerial cooperation and keeping up with the international development, promote applications, continue to conduct environmental distribution investigation, cautiously evaluate newly listed substances, and strengthen public education and advocacy communication and participate in international cooperation,

gradually eliminate or reduce the emission of persistent organic pollutants in the environment, and work globally for a future without persistent organic pollutants

Appendix

「Stockholm Convention on Persistent Organic Pollutants National Implementation Plan」 Table of 2019 Implementation Results

「Stockholm Convention on Persistent Organic Pollutants National Implementation Plan」

Table of 2019 Implementation Results

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
(I). Regarding the controlled substances in the appendix A, B under the Convention			
A.According to the authorities and responsibilities of the competent authority, in response to international trends, strengthen the management system, implement, and revise relevant laws and regulations	**Environmental Protection Administration of the Executive Yuan** (A) According to the authorities and responsibilities of the competent authority, in response to international trends, implement and revise relevant laws and regulations	(A) Keep up with the international trend in Convention management status, consolidate POPs management methods from foreign countries, research and propose control recommendations for our country, and update domestic National Implementation Plan.	Toxic and Chemical Substances Bureau
		(B) Continue to implement source prohibition and restriction management based on relevant laws and regulations such as "Toxic and Concerned Chemical Substances Control Act", "Environmental Agents Control Act".	Toxic and Chemical Substances Bureau
		(C) On March 5, 2019, according to the classification of toxic substances by the「Toxic and Concerned Chemical Substances Control Act」, the classification of decabromodiphenyl ether was revised from Class 4 toxic chemical substances to Class 1 and Class 2 toxic chemical substances；the control concentration was strictly revised from 30 w/w% to 1 w/w% and added mass operation criteria as 50 kg.	Toxic and Chemical Substances Bureau
		(D) On March 5, 201, according to the「Toxic and Concerned Chemical Substances Control Act」the operational management of hexachloro-1, 3-butadiene was revised, to prohibit manufacture, import, sell and use, except for experiment, research, and education.	Toxic and Chemical Substances Bureau
		(E) On March 5, 2019, in response to international trend, according to the「Toxic and Concerned Chemical Substances Control Act」, it was publicized that short-chain chlorinated paraffin is Class 1 toxic chemical substances, control concentration as 1 w/w%, mass operation criteria as 100 kg, which is prohibited in toys and children products, except for 10 applications in experiment, research, and education 10.	Toxic and Chemical Substances Bureau
	(B) Add and revise environmental testing standard methods, increase environmental testing technical capabilities, assure national testing data quality	Test method of polychlorinated naphthalene in environmental elements - isotope labeling dilution/gas chromatography/high resolution or tandem mass spectrometer (NIEA M908.00B) (December 18, 2019 EPA test no. 1081007880 publication）.	Environmental Inspection Institute
	Ministry of Economic Affairs (A) Comply with the publicize POPs import and export regulation by the competent authority of goods.	Since the competent authority of goods did not ask this bureau to formulate the relevant product classification number list and import and export regulations, there was no relevant result.	Bureau of Foreign Trade, MOEA
	(B) Research relevant POPs pollution prevention assistance and substitute measures, and provide technical assistance to the restricted industry	The environmentally friendly fluorine-free water repellent independently developed by the Textile Research Institute does not contain perfluorocarbon octyl (PFOS/PFOA) compounds. The product is currently promoted to the textile industry for finished fabric treatment and replace fluorine-containing water repellent. Presently, Textile Research Institute continued to assist the industry in investing into production of textile additives and applications; besides, to meet the industrial needs, to produce custom products of fluorine-free water repellent（model：WR28）, and accelerate the deepening development of substitutes by expanding the industrial scale of fluorine-free products, and continue to work towards the goal of zero-fluorocarbons (PFCs) in the industrial process chain.	Industrial Development Bureau
	(C) In response to international trend, timely review or assess the feasibility to include the products possibly containing POPs（such as electronic appliances, building materials etc.） in the testing scope, and assess the feasibility of including POPs in the related CNS national standards	(A) In 2019, it was publicized that for products that should be tested, such as wireless charger and electronic toilet seat, the testing items add the restricted substances in CNS 15663 Section 5 (including polybrominated biphenyls and polybrominated diphenyl ether）「content labeling」requirement. (B) CNS 15290「Textile product safety regulations (general requirements)」was revised to add that perfluorooctane sulfonic acid in textile products or coatings must not exceed 1μg/m$^{(B)}$	Bureau of Standards, Metrology, and Inspection
	(D) Add and revise product testing standard method, increase testing	CNS 18219 "Leather-Determination of Chlorinated Hydrocarbons in Leather-	Bureau of Standards,

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
	technical capabilities	Chromatography of Short-chain Chlorinated Paraffin (SCCP)" was formulated, to include the chromatography for C_{10}~C_{13} short-chain chlorinated paraffin content in treated or untreated leather.	Metrology, and Inspection
	MOHW According to the international trend, continue to review or add or revise food safety and hygiene regulations or standards	In 2019,「Residual tolerance standard for agro pesticides」was revised and publicized.	Food and Drug Administration
	Ministry of Finance (A) According to the「Regulations for Customs Administration of Import and Export Trade」, cooperate with various competent authorities to implement border control on imported and exported goods.	(A) The customs and the Bureau of Foreign Trade collaborate to formulate the import and export regulations, and according to the various competent authorities, formulate the import and export regulations for customs clearance operations, the current approval process has been included in the electronic document comparison, and the customs are the competent authority, and verify the information, and then start customs clearance and release, and after release, submit the declaration data to the customs and port trade through single window for the approval agency to check and grasp the import and export data.	Customs Administration
	(B) According to the Statistics on Import and Export Trade of the Republic of China, conduct statistics of import and export quantity of POPs	(B) According to the Statistics on Import and Export Trade of the Republic of China, in the import of 2019, except that dioxin and furan were unintentionally derived chemical substances, and all were by-products from manufacturing process, and there was no data. , the import of decabromodiphenyl ether was about 4 kg, and the import of other substances was less than 1 kg or zero, and the export of controlled POPs was all zero. For short-chain chlorinated paraffin, currently only import and export volume of chlorinated paraffin is available.	Customs Administration
	Council of Agriculture of the Executive Yuan (A) according to the authorities and responsibilities of the competent authority, timely respond to international trend, and review and add and revise relevant regulations	Continue the management in accordance with the regulations in「Agro-Pesticides Management Act」,「Fisheries Act」,「Veterinary Drugs Control Act」,「Feed Control Act」and「Agricultural Production and Certification Act」	Bureau of Animal and Plant Health Inspection and Quarantine, Fisheries Agency, Department of Animal Industry
	(B) Assist farmers in using substitutes of POPs agro pesticides	NA	Bureau of Animal and Plant Health Inspection and Quarantine
	Ministry of Labor According to the「Occupational Safety and Health Act」, Jointly strengthen the source management of chemicals and take appropriate measures to strengthen the protection of labor safety and health.	Prepare examples of GHS labeling and safety data sheet reference for the industry and the public to understand their hazardous nature and related preventive measures	Occupational Safety and Health Administration
B. Conduct random sampling and testing of environment, organism, foods, and commercial products	**Environmental Protection Administration of the Executive Yuan** (A).Conduct river environmental investigation and testing	(A). Focus was on 15 rivers to conduct the environmental distribution investigation of 25 PBDEs. The investigation result shows that the weight average concentration and range of PBDEs in river sediments was 17, 943 (281-401, 946) ng/kg dry weight. Among 15 rivers, Erren Creek had the highest average concentration in river sediments 82, 377 ng/kg dry weight, and the next was Nankan River 78, 507 ng/kg dry weight, and there was a decreasing trend in the rivers which had relatively high value in the past, including Kaya Creek and Dianbao Creek. The weight average concentration and range of PBDEs in fish bodies was 502 (48.3-2, 359) ng/kg wet weight.	Toxic and Chemical Substances Bureau
		(B). Focus was on 15 rivers to conduct the environmental distribution investigation of 5 kinds of hexabromobiphenyl homologues in 122 samples of river sediments, and the weight average concentration and range of hexabromobiphenyl homologues in river sediments was 41.5 (0.133-2, 184) ng/kg dry weight, and the concentration in river sediments of some rivers in the rainy season was higher than that in the dry season. The average	Toxic and Chemical Substances Bureau

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
		concentration, 575 ng/kg dry weight, for Erren Creek was the highest, the next was Houlong Creek 20.5 ng/kg dry weight. The weight average concentration and range of hexabromobiphenyl homologues in fish bodies was 4.39 (0.194-45.7) ng/kg wet weight, and among all the average concentration 33.2 ng/kg wet weight for Erren Creek was the highest and Wu Creek 5.58 ng/kg wet weight was the next.	
		(C). Analysis for 15 rivers was completed, and the average concentration and range for all 122 samples of river sediments was <0.05 (ND-0.204) μg/kg dry weight. In dry season, the average concentration 0.054 μg/kg dry weight for Zhonggang Creek was the highest; in rainy season, all 15 rivers were negative, indicating river sediments after flushing the environmental hexachlorobutadiene was reduced to below the quantitative range（0.05μg/kg dry weight）. The average concentration and range of hexachlorobutadiene in fish bodies from 15 rivers was <0.025 (ND-0.138) μg/kg wet weight, and among all only the analytical result for fish body from Zhonggang Creek was positive, with the concentration as high as 0.691 μg/kg dry weight（0.138 μg/kg wet weight）, which indicated that the hexachlorobutadiene content and detection rate for river sediments and fish bodies were low.	Toxic and Chemical Substances Bureau
		(D). Analysis was conducted on 122 samples of sediments from 15 rivers and 45 samples of fish bodies regarding short-chain chlorinated paraffin, and for SCCPs of 55.5% chlorine content in sediments from 15 rivers, Erren Creek had the highest average concentration 2.35 mg/kg dry weight, and Nankan River and Dianbao Creek had 1.74 mg/kg dry weight as the next；for SCCPs of 63% chlorine content in river sediments, Erren Creek had the highest average concentration 1.66 mg/kg dry weight, and Saltwater Creek had 0.822 mg/kg dry weight as the next.	Toxic and Chemical Substances Bureau
	(B). Conduct investigation of environmental water body（e.g. reservoir）	(A).Monitoring was on 10 testing points of rivers, and 2 testing points of reservoirs, for persistent organochlorine agro pesticides (including Dieldrin, Endrin, Aldrin, Toxaphene, Heptachlor and derivatives, DDT and derivatives, Lindane, and Endosulfan）, and all were ND, meeting the relevant domestic standard values.	Department of Environmental Monitoring and Information Management
		(B).Investigation was conducted on Sanyegong Creek, Nankan River, Saltwater Creek, and Taliaokeng Creek for perfluorooctane sulfonic acid, and the concentration was N.D.(MDL=1.94ng/L)~3, 904 ng/L.	Environmental Inspection Institute
	(C). Conduct testing of drinking water quality	Focus was on tap water supply system for testing of drinking water quality, including Lindane（34 times）and Endosulfan（34 times）, all meeting drinking water quality standard. 50 sites of water purification plants were tested, and the PFOS range in clear water was ND （method detection limit 1.2 ng/L～87 ng/L.	Department of Water Quality Protection
	(D). Conduct concentration investigation of industrial wastewater	Investigation of the industry possibly operating with perfluorooctane sulfonic acid（printing and finishing industry, textile industry and chemical industry）was conducted for industrial wastewater for 10 times, and in 3 times the concentration of perfluorooctane sulfonic acid was below method detection limit, while others were 2.45~24.3 ng/L；besides, the investigation of discharged water or controlled water was conducted for 10 times, and the concentrations of perfluorooctane sulfonic acid were all below method detection limit.	Department of Water Quality Protection
	(E). Investigate environmental soils, groundwater, and sediments	(A) Investigation of concentrations of agro pesticides POP（including Aldrin, Chlordane, DDT, Dieldrin, Endrin, heptachlor, hexachlorobenzene, Toxaphene, Endosulfan） and their derivatives in 13 samples of river sediments, and the concentrations of agro pesticides POPs in	Soil and Groundwater Remediation Fund Management Board

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
		most sediments were below method detection limit or quantitation limit, and the concentrations of agro pesticides POPs in all sediments were all below sediments quality index lower limit.	Soil and Groundwater Remediation Fund Management Board
		(B) Investigation was conducted for 13 samples of river sediment for the concentration of polychlorinated biphenyl, and the concentrations of polychlorinated biphenyl in all sediments were below method detection limit or quantitation limit.	Soil and Groundwater Remediation Fund Management Board
		(C) Sampling and testing were conducted for polychlorinated biphenyl baseline content in soils from 62 monitoring points, and all were ND, and in 29 monitoring points of a designated area the concentration range was ND~0.0227 mg/kg, below soil pollution control standards(0.09 mg/kg).	Soil and Groundwater Remediation Fund Management Board
		(D) Sampling and testing were conducted for polybrominated diphenyl ether from 106 monitoring points, and the concentration range was 1.87～88.1 μg/kg, and in 111 monitoring points of a designated area the concentration range was 0.904～511 μg/kg, without corresponding soil pollution control standards.	Soil and Groundwater Remediation Fund Management Board
		(E) Sampling and testing were conducted for hexachlorobutadiene baseline content in soils from 62 monitoring points, and in 111 monitoring points of a designated area all were ND.	Soil and Groundwater Remediation Fund Management Board
		(F) Sampling and testing were conducted for pentachlorophenol baseline content in soils from 62 monitoring points, and in 40 monitoring points of a designated area all were ND, all below soil pollution control standards (200 mg/kg).	Soil and Groundwater Remediation Fund Management Board
		(G) Sampling and testing were conducted for PFOS baseline content in soils from 62 monitoring points, and the concentration range was ND ～ 6.64 μg/kg, in 24 monitoring points of a designated area the concentration was ND～34.9 μg/kg, without corresponding soil pollution control standards.	Soil and Groundwater Remediation Fund Management Board
		(H) Sampling and testing were conducted for chlorinated naphthalene baseline content in soils from 22 monitoring points, and the concentration range was 7.84～199 ng/kg, in 6 monitoring points of a designated area the concentration was 27.0～128 ng/kg, without corresponding soil pollution control standards.	Soil and Groundwater Remediation Fund Management Board
		(I) With focus on optoelectronic semiconductor and textile industries, investigation of perfluorinated compounds in groundwater was conducted, and on-site investigation and interview for 50 optoelectronic semiconductor companies and 4 sites of sewer treatment plants was conducted, sampling was conducted for 64 wells of groundwater ; besides, 16 textile related companies were selected for sampling and investigation of process water and discharged water, and sampling was conducted for 29 wells of groundwater. The testing result for perfluorooctane sulfonic acid in groundwater from optoelectronic semiconductor industry was ND~4, 767 ng/L ； the testing result for perfluorooctane sulfonic acid in groundwater from textile industry was ND~171 ng/L.	Soil and Groundwater Remediation Fund Management Board
		(J) The concentration range of agro pesticides POPS in sediments from 30 river ditch monitoring points in Kaoping area was ND-1,668 ng/kg d.w., all fairly low; the concentration of hexabromodiphenyl ether and heptabromodiphenyl ether was 0.146-163（average value was 130.2）ng/kg d.w. ；the concentration of tetrabromodiphenyl ether and pentabromodiphenyl ether was 1.49-29, 100（average value was 790.6）ng/kg d.w.	Environmental Inspection Institute
	Ministry of Economic Affairs Conduct testing of commercial products containing POPs	According to CNS 14729「Test method for pentachlorophenol preservatives in wood」, the test was conducted for pentachlorophenol	Bureau of Standards, Metrology, and

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
		preservative in 20 wood panel products from market, including composite wood flooring, laminated veneer lumber, general plywood, medium density fiberboard, and decorative glulam, and the result was ND for pentachlorophenol and pentachlorophenol sodium (method detection limit was 0.1 kg/m^3) in all 20 samples.	Inspection
	MOHW Conduct sampling and analysis of food products from market	5,164 samples of commercial agricultural products were analyzed, and all were ND for residual agro pesticides (organochlorine agro pesticides, α-, β- hexachlorocyclohexane and Lindane, Endosulfan in the first controlled group), compliant with domestic standards and regulations.	Food and Drug Administration
	Council of Agriculture of the Executive Yuan Conduct sampling and analysis of agricultural, fishery, and livestock products	(A) To comply with the EU requirement of hygiene certificate on imported edible honey products for human consumption, the residual polychlorinated biphenyl in honey products from bee farms was tested and all 33 random samples had no residue. (B) 14, 587 samples of crops like rice, vegetables, and fruits were tested, and except that 1 sample of pumpkin was detected for Dieldrin (the edible crops on the ground have been eradicated and destroyed, but have not been introduced into the market), all others were not detected for any controlled organochlorine agro pesticide (detection limit：0.01ppm) under the Convention or compliant with food safety and hygiene regulations.	Agriculture and Food Agency Agriculture and Food Agency
(II). Regarding the controlled substances in the appendix C under the Convention (such as unintentional derivatives, dioxin and furan)			
A. According to the authorities and responsibilities of the competent authority, and in response to international trend, timely review and add and revise relevant regulations, reduce dioxin emission and human health hazards	**Environmental Protection Administration of the Executive Yuan** (A). in response to international trend, timely review and add and revise relevant regulations, and take measures to reduce emission	(A) To strengthen dioxin emission control, "Dioxin control and emission standards for waste incinerators", "dioxin control and emission standards for small and medium waste incinerators", "dioxin control and emission standards for electric arc furnaces in the steelmaking industry", "dioxin control and emission standards for sintering plants in the iron and steel industry", "dioxin control and emission standards for high-temperature smelting facilities in the iron and steel industry" and "stationary pollution source dioxin emission standards" have been publicized, to put all emission of dioxin and furan from stationary pollution source under control. (B) For the control measures of dioxin and furan, it is mainly to strengthen the audit and testing for pollution sources, and implement regulatory control, and in accordance with domestic emission inventory control and environmental air monitoring, to understand domestic emissions and air quality status and changing trends, as a reference for reviewing the control direction. (C) To strengthen the control of dioxin discharged water emission, on April 29, 2019, the ``discharged water standard'' and the applicable conditions of waste incineration facilities were revised, which is not limited to those treating or producing wastewater into the wastewater treatment facilities. Besides, in accordance with the industrial classification by the Water Pollution Control Act and new defined steam supply industry, based on the process of manufacturing steam in the industry, the waste gas produced by wet treatment of waste gas contains dioxin and other pollutants, so the applicable dioxin standards were formulated.	Department of Air Quality Protection and Noise Control Department of Air Quality Protection and Noise Control Department of Water Quality Protection
	(B). Conduct investigation, audit and testing of emission from stationary pollution source	(A) According to the provisions of the Air Pollution Control Act, those non-conforming to emission standards will be subject to penalties and correction within time limit. (B) The industry conducted 449 times of regular testing of dioxin from emission pipelines, and the environmental protection agencies	Department of Air Quality Protection and Noise Control, Department of Air Quality Protection and

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
		conducted 87 times of regular testing of dioxin from emission pipelines, and the results from 4 times of testing exceeded the limit, among them, 3 times of testing were waste fueled boiler, 1 time was industrial waste incinerator, and all were notified and penalized by the environmental agency and subject to continuous correction. (C) 6 times of sampling and testing of dioxin in emission from stationary pollution source were conducted, and the result range was 0.005 ~0.279 ng-TEQ/ Nm^3, all compliant with emission control standards.	Noise Control Bureau of Environmental Inspection
	(C). Add and revise environmental testing standard method, to increase environmental testing technical capabilities	Sampling method of dioxin and furan in water (NIEA W790.51B) (November 20, 2019 EPA test No. 1080006959 publication)	Environmental Inspection Institute
	MOHW According to the international trend, review or add and revise food safety and hygiene regulations or standards	According to the regulations in the Act Governing Food Safety and Sanitization and Management mainly for foods containing dioxin and polychlorinated biphenyl, continue to put control over domestic food products	Food and Drug Administration
	Council of Agriculture of the Executive Yuan According to the authorities and responsibilities, timely review and add and revise relevant regulations.	According to the regulations in the "Agro-Pesticides Management Act", "Fisheries Act", "Veterinary Drugs Control Act", "Feed Control Act", and "Agricultural Production and Certification Act", continue regulatory control.	Bureau of Animal and Plant Health Inspection and Quarantine, Fisheries Agency , Department of Animal Industry, Agriculture and Food Agency
	Ministry of Economic Affairs Conduct industrial assistance with dioxin pollution control, waste recycle and clean production	Continue industrial assistance with pollution control of dioxin, waste recycle and clean production	Industrial Development Bureau
B. Establish emission inventory and conduct analysis of reduction results	**Environmental Protection Administration of the Executive Yuan** (A). Establish emission inventory	In 2018, the national emission was 51.01 g I-TEQ, compared to 2002 at 327.5 g I-TEQ, reduced by 84%, showing the decreasing trend over the years.	Department of Air Quality Protection and Noise Control
	(B). Conduct analysis of reduction results	(A) In 2001, due to the implementation of existing large-scale waste incinerator standards, large-scale incinerator emissions have greatly improved, and domestic main emission was changed to electric arc furnaces and sintering furnaces, together accounting for 66%. In 2002, EPA expanded testing for domestic emission source, and continued to find medium and small industrial waste incinerators ; at the same time, the steel industry was recovering, and the steel production increased by 15%, and the total emission reached 327 g I-TEQ/year. (B) In 2004, the first stage electric arc furnace standards become effective and the small incinerator standards became effective, so the percentage of electric arc furnaces was dramatically reduced. In the same year, because Taiwan Steel Union did not improve and had increased dust and ash collection, therefore, the emission of ash collection high-temperature smelting facilities has increased significantly. (C) During 2006~2008, the ash collection high-temperature smelting facility standards, and the electric arc furnace and sintering furnace second stage standards became effective, and the emission of steel industry as previously main source was greatly reduced, and the emission structure of various industries became steady. In 2018, the emission was 51.01 g I-TEQ/year, compared to 2002, reduced by 84%.	Department of Air Quality Protection and Noise Control Department of Air Quality Protection and Noise Control Department of Air Quality Protection and Noise Control
C. Conduct random sampling and testing of environment, organism, and foods.	**Environmental Protection Administration of the Executive Yuan** (A) Monitoring and testing of environmental air, river environment and water bodies.	(A) Dioxin environmental air monitoring was conducted, and the average concentration value was 0.021 pg I-TEQ/m^3, compared to 2002 at 0.089 pg I-TEQ/m^3, the monitored average concentration in 2003 was significantly reduced, and all values were	Department of Air Quality Protection and Noise Control

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
		below Japanese environmental air dioxin standard (0.6 pg WHO2005-TEQ/m^3). (B) In Kaoping area, the investigation was conducted for 30 river and ditch monitoring points, and the distribution range of dioxin total toxic equivalent in sediments was 0.005 - 5.64 WHO-TEQ/kg d.w., and the distribution range of dioxin type polychlorinated biphenyl total toxic equivalent was 0.00003-0.696 ng WHO-TEQ/kg d.w.	Environmental Inspection Institute
	(B) Investigation of environmental soils, groundwater, and sediments	(A) Sampling and testing was conducted for dioxin baseline content in soils from 106 monitoring points, and the concentration range was 0.071～20.3 ng I-TEQ/kg, and the concentration range for 67 monitoring points in the designated area was 0.239～48.6 ng I-TEQ/kg, below soil pollution control standards(1,000 ng I-TEQ/kg).	Soil and Groundwater Remediation Fund Management Board
		(B) The investigation of concentration of dioxin and furan in 13 samples of river sediments, and the concentration rage for dioxin and furan was 0.185～8.700（average value was 3.470）ng I-TEQ/kg, and among all, the concentration of dioxin and furan near the Xucuogang No.1 Bridge of Laojie Creek, and the Ohorikei Creek Bridge and the Huanxiang Bridge of Ohorikei Creek exceeded the sediments quality index lower limit (6.82 ng I-TEQ/kg).	Soil and Groundwater Remediation Fund Management Board
	(C) Testing of drinking water	Random sampling and testing of dioxin was conducted for drinking water quality in three sites of domestic water purification plants, and the values were compliant with the drinking water standards.	Department of Water Quality Protection
	(D) Conduct investigation of concentration in industrial discharged water	The investigation results for industrial discharged water（10 times） were all compliant with the discharged water standard control limit (10 pg-I-TEQ/L).	Department of Water Quality Protection
	Council of Agriculture of the Executive Yuan Conduct sampling and analysis of agricultural, fishery and livestock products.	(A) 47 samples of feeds and feeds additives were tested, and the values for all samples were all below the domestic control limit of dioxin, furan and polychlorinated biphenyl in feeds.	Agriculture and Food Agency
		(B) According to the data regarding the dioxin emission from the emission pipelines（chimney）of non-conforming factories and other high pollution potential factories, and with focused sampling of crops from neighboring farmlands, in 2019, 12 samples of crops were tested for contents of dioxin, furan and dioxin type polychlorinated biphenyl, and among all, 2 samples exceeded the dioxin EU fruit and vegetable action control value(0.3 pg WHO_{2005}-TEQ/g f.w.), and the non-conforming companies were subject to regulatory action and control by local government, and the content of dioxin type polychlorinated biphenyl was 0.006-0.0634 pg WHO_{2005}-TEQ/g f.w, not exceeding the EU crops action control value.	Fisheries Agency, Agricultural Chemicals and Toxic Substances Research Institute
		(C) Aquatic products before market were tested for dioxin and dioxin type polychlorinated biphenyl（54 samples）, and the testing results were all compliant with the food hygiene standards.	
	MOHW Conduct sampling and analysis of foods from market	(A). 40 samples of commercial foods from Yilan area were tested for dioxin, furan and dioxin type polychlorinated biphenyl, and the total concentration average value for various food products was 0.002-0.06 pg WHO_{05}-$TEQ_{PCDD/F}$/g wet weight, 0.0003-0.019 pg WHO_{05}-TEQ_{PCB}/g wet weight.	Food and Drug Administration
		(B). 57 samples of commercial foods from outlying area were tested for dioxin, furan and dioxin type polychlorinated biphenyl, and the total weight concentration average for various food products was 0.002-0.18 pg WHO05-TEQPCDD/F/g wet weight, 0.001-0.143 pg WHO05-TEQPCB/g wet weight.	Food and Drug Administration
(III). Other management			
A. Identify and assess	**Environmental Protection**		

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
the sites polluted by POPs, and reduce environmental hazards by such sites	**Administration of the Executive Yuan** (A) According to the 「 Soil and Groundwater Pollution Remediation Act 」, conduct the investigation of pollution potential of groundwater in soils, emergency measures, pollution improvement and remedies. (B) Continue to investigate the sites that have exceeded the pollution control standard for POPs by the Soil and Groundwater Remediation Fund Management Board and build the site list and take measures to reduce hazards.	According to the 「 Soil and Groundwater Pollution Remediation Act 」, the investigation of pollution potential for groundwater in soils was conducted, along with emergency response, pollution improvement and remedies. In 2019, there was no publicized site that was newly added or removed for POPs pollution.	Soil and Groundwater Remediation Fund Management Board Soil and Groundwater Remediation Fund Management Board
B. Properly handle wastes containing POPs.	**Environmental Protection Administration of the Executive Yuan** (A) According to the Waste Disposal Act, properly handle wastes containing POPs (B) Provide types, temporary storage location and capacity, disposal quantity, disposal location and disposal methods for POPs.	The information regarding waste disposal and storage has been provided. For details, please see the content of the article.	Department of Waste Management
C. Strengthen risk communication and advocacy	**Environmental Protection Administration of the Executive Yuan** According to the authorities and responsibilities, strengthen public awareness of POPs, and timely communicate and advocate with media and the public, to reduce public concerns.	“Persistent organic pollutants (POPs) information” website was constantly updated, and “Investigation Information of Environmental Distribution of Toxic Chemicals” website was established.	Toxic and Chemical Substances Bureau
	MOHW (A) Conduct health risk assessment of domestic dietary exposure	(A). The life-time average daily dose (LADD) in Yilan area was 0.108 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day (life-time average weekly dose was 0.759 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/week) , compliant with WHO tolerable daily intake (TDI) 1-4 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day and EFSA tolerable weekly intake (TWI) suggested value 2 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/week. (B). The estimated life-time average daily dose (LADD) in outlying islands was 0.344 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day (life-time average weekly dose was 2.406 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/week) , compliant with WHO tolerable daily intake (TDI) 1-4 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/day, but exceeding the EFSA tolerable weekly intake (TWI) suggested value 2 pg WHO-$TEQ_{PCDD/F+PCB}$/kg BW/week.	Food and Drug Administration
	(B) According to the authorities and responsibilities, strengthen public awareness of POPs, and timely communicate and advocate with media and the public, to reduce public concerns.	(A). In the "homepage/services/food/Endocrine Disrupting Substances (Environmental Hormones) /common Endocrine Disrupting Substances" of our website, place risk communication posts for download and reference. (B). Caring for the health of patients with oil disease (polychlorinated biphenyl contaminated rice bran oil in 1979), conducting regular visits, providing health education, health information, medical referral and consulting services for patients with oil disease; organizing education and training for health care workers for patients with oil disease, arranging relevant courses on understanding the effects of polychlorinated biphenyl and the disease on patients; use of "Health Education Manual for Patients with Oil Disease" to provide patients with oil disease and medical workers with reference in health education. (C). As of the end of December 2019, a total of 1,884 patients have been registered and served, and individual visits, care and consultation services were provided regularly. (D). Organize the event of education and training for health care workers of oily patients (all local government health agencies (institutes, health service centers), medical institutions, a total of 72 participants), and through professional education, to improve the	Food and Drug Administration Health Promotion Administration Health Promotion Administration Health Promotion Administration

Implementation Method	Work Item	Implementation Result	Implementation Agency (unit)
		capacity of health care workers for polychlorinated biphenyl poisoning Knowledge. (E). A total of 7 health promotion activities for oily patients were held in Taichung and Chunghua area for oily patients (103 patients participated), free transportation, health check services and health promotion seminars (such as environmental hormones, nutrition and health education, chronic disease prevention and care, Chinese medicine health care, health care medicated diet and health food and other health knowledge dissemination).	Health Promotion Administration
	Ministry of Economic Affairs According to the authorities and responsibilities, strengthen public awareness of POPs, and timely communicate and advocate with media and the public, to reduce public concerns.	Through "Industrial Green Technology Information" (website https://proj.ftis.org.tw/eta/) , provide "persistent organic pollutants (POPs) information" website link, to assist with advocacy.	Industrial Development Bureau
	Council of Agriculture of the Executive Yuan According to the authorities and responsibilities, strengthen public awareness of POPs, and timely communicate and advocate with media and the public, to reduce public concerns.	(A). To reduce the dioxin pollution caused by open burning, COA continued to advocate the concept of straw treatment to farmers. Through press releases, electronic billboards and gatherings of farmers and other channels, farmers were encouraged to pick up straw and chop them before landfill. (B). Various agricultural agencies at all levels (units) continued to advocate and provided various counseling measures. The straw was mainly treated by cutting and burying in the soils, and the rest was recycled and reused as bedding, mulching material, cultivation medium, compost, or fuelwood.	Agriculture and Food Agency Agriculture and Food Agency
	Ministry of Labor According to the authorities and responsibilities, conduct occupational safety and health advocacy	(A).Prepare examples of GHS labeling and safety data sheets for chemical substances, for manufacturers and the public to understand their hazardous nature and related preventive measures. (B).The above-mentioned reference materials were put on the GHS Chemicals Global Harmonization System website, which can be downloaded and used by manufacturers and the public. The average number of monthly visits on the website exceeded 100,000 times.	Occupational Safety and Health Administration Occupational Safety and Health Administration