NEPAL PFAS Country Situation Report

Center for Public Health and Environmental Development (CEPHED)
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Summary

The Federal Democratic Republic of Nepal is a landlocked country in South Asia with a population of 29 million. It borders China in the north and India in the south, east, and west. Despite not being an industrialized country, it imports all sorts of chemicals for industrial and agricultural use in addition to products containing chemicals consumed by the public. Nepal has been a party to Stockholm Convention on Persistent Organic Pollutants (POPs) since 2006 and submitted its first National Implementation Plan (NIP) to the secretariat in 2007. Nepal submitted an updated NIP in 2017 with some information on PFAS (PFOS and PFOA).

The key findings of this report are:

- PFAS substances have been measured in Nepal water and soil, including in an agricultural area with little industrialization. Substances measured include PFOS, PFOA, and PBFS.
- PFAS precursor substances have been found in house dust in Nepal.
- PFAS monitoring would help establish an initial inventory of hotspots.
- There is no specific legislation to regulate the import, sale, distribution and uses of PFOS- and PFOA-containing products or chemicals in Nepal.
- A market survey indicates products potentially containing or using PFAS substances are widely available and in use, including kitchen ware, utensils, and firefighting foams.
- Products labeled as "PFOA-free", "No PFOA, or "No PTFE" are increasing available on the market.
- A full inventory of PFOS and PFOA is planned with high priority.
- Actions to control and phase-out PFAS as a class contribute to achievement of several key Sustainable Development Goals (SDGs) due to the impacts of the substances on health and ecosystems including water pollution. These include SDGs 3, 6, 9, 12, 14, 15, and 16.

What are per- and polyfluoroalkyl substances (PFAS)?

PFAS is a large class of more than 4,500 persistent fluorinated chemicals. PFAS are both hydrophobic and lipophobic in nature and extremely persistent due to the strength of the carbon-fluorine bond. They are widely distributed in the global environment due to their high solubility in water, low/moderate sorption to soils and sediments and resistance to biological and chemical degradation. The properties of PFAS have resulted in extensive use as surfactants and surface-active agents in products. Two widely-used members of this class have been perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). As these two substances have come under regulatory pressure, the industry has shifted to other PFAS with similar properties.

Human exposure to PFAS is mainly by ingestion of contaminated food or water. These substances bind to proteins (not to fats) and persist in the body where they are mainly detected in blood, liver and kidneys. Studies indicate that PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals cause tumors in animal studies along with a variety of other effects on infant birth weight, growth, learning, infant behavior, pregnancy, endocrine system, increased cholesterol, and thyroid function. Recent studies have linked a variety of PFAS substances to many human health effects: cardiovascular disease, markers of asthma, damage to semen quality, ovarian insufficiency, altered glucose metabolism, lower testosterone levels in male adolescents, association with shorter birth length in girls, elevated blood pressure, abnormal menstruation, lower birth weight in infants, possible increased risk of female infertility due to endometriosis, and decreased lung function in children with asthma.

The manufacture and use of PFAS and their use in a multitude of products has caused widespread pollution. PFAS are found in wildlife, accumulating in the blood, liver and kidneys of wildlife such as dolphins, polar bears, seals, birds, fish, and other marine wildlife. PFAS substitutes for PFOS and PFOA have been identified as potential global surface water contaminants and they have been found in more than 80% of 30 surface seawater samples from the North Pacific to Arctic Ocean. PFAS use in firefighting foams at military bases and airports is responsible for water pollution and contaminated communities in many countries, including Australia, Canada, China, Germany, Italy, Japan, Netherlands, New Zealand, South Korea, and Sweden.

The Danish EPA has found high levels of perfluoroalkyl and polyfluoroalkyl substances (PFASs) in almost one third of 17 analyzed cosmetics products. PFASs are used in foundations, moisturizers, eye shadows, and shaving creams for their surfactant properties, which help creams to better penetrate the skin. The EPA recently tested the products and said that, while one or more PFASs were identified in all the analyzed products, the levels in six exceed those in forthcoming REACH restrictions. For two products (both foundations) perfluorooctanoic acid (PFOA) was found in concentrations above the REACH restriction limit of 25 parts per billion (ppb) – or 25 nanograms per gram (ng/g) – which will enter into force on 4 July 2020. Meanwhile, in six products concentration limits exceeded that of a proposed REACH restriction for C9-C14 perfluoroalkyl acids or perfluorocarboxylic acids (PFCAs).

Safer cost competitive non-fluorinated alternatives for PFAS use in firefighting foams have been adopted by an increasing number of major airports, including Auckland, Copenhagen, Dubai, Dortmund, Stuttgart, London Heathrow, Manchester, and all 27 major airports in Australia. Increasing awareness about the negative characteristics of PFAS has driven efforts to identify and market safer substitutes for other uses. Increasing awareness about the negative characteristics of PFAS has driven efforts to identify and market safer substitutes for other uses. Due to the complexity and negative characteristics of PFAS, there is increasing interest in regulating PFAS as a class rather than as individual substances.

PFOS

PFOS and its related substances have been used in a variety of products and processes including firefighting foams, carpets, leather goods, upholstery, packaging, industrial and household cleaning products, pesticides, photographic applications, semiconductor manufacturing, hydraulic fluids, catheters and metal plating. PFOS is extremely persistent and has shown no degradation under any environmental condition that has been tested. It is toxic to mammals and high concentrations have been found in Arctic animals, far from anthropogenic sources. PFOS is regularly detected in human blood and breast milk. For example, in one study of 299 infants, PFOS was found in the blood of 297 of them and PFOA was found in all of them.

PFOA

PFOA has been used to make non-stick pans, and is found in textiles, fire-fighting foams, and medical devices, and is used in many other products and processes. In 2017, the Stockholm Convention POPs Review Committee noted the link between PFOA and serious illnesses in humans, including diagnosed high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer and pregnancy-induced hypertension. PFOA has contaminated the global environment, including wildlife and people of remote regions such as the Arctic and Antarctic.

For more information about recent research on the impacts of PFAS, including fluorinated substitutes for PFOS and PFOA, please see Annex 1. Information about the high cost of PFAS pollution cleanup is available in Annex 2. Global regulation of PFAS through the Stockholm Convention and evaluations of its expert committee is discussed in Annex 3.

Actions on PFAS and the Sustainable Development Goals

Actions to control and phase-out PFAS as a class contribute to achievement of several key Sustainable Development Goals (SDGs) due to the impacts of the substances on health and ecosystems including water pollution. These include:

Sustainable Development Goal 3: Ensure healthy lives and promote well-being for all at all ages. Targets under SDG3 include:
3.4: *"reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being"*
3.9: *"substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination."*

Sustainable Development Goal 6: Ensure availability and sustainable management of water and sanitation for all. Targets under SDG6 include:
6.3: *"improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally."*

Sustainable Development Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Targets under SDG9 include:
9.4: *"greater adoption of clean and environmentally sound technologies and industrial processes."*

Sustainable Development Goal 12: Ensure sustainable consumption and production patterns. Targets under SDG12 include:
12.4: *"By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frame works, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment."*
12.5: *"substantially reduce waste generation through prevention, reduction, recycling and reuse."*
12.6: *"Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle."*
12.7: *"Promote public procurement practices that are sustainable, in accordance with national policies and priorities."*

Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. Targets under SDG14 include:
14.1: *"By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution."*

Sustainable Development Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Targets under SDG15 include:
15.1: *"By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements."*
15.5: *"Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species."*
15.9: *"By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts."*

Sustainable Development Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. Targets under SDG16 include:
16.7: *"Ensure responsive, inclusive, participatory and representative decision-making at all levels."*
16.10: *"Ensure public access to information…"*

PFAS production, use, and waste management

Geography and population of Nepal

Nepal has a total area of 147,181 km² that extends from 60 meters above sea level in the south to 8,848 m high at Mt. Everest in the north within a short distance of 160 Km. The country is situated in the mid-Himalayas within the latitudes 26°22'N to 30°27'N and longitudes 80°04'E to 88°12'E in the northern hemisphere.

The average east to west length of the country is 885 Km and north to south width is 193 Km. With a wide range of topography, Nepal experiences different types of climate (tropical, sub-tropical, temperate, sub temperate and alpine). The country shares a border with China in the north and India in the south, east and west.

The total population of the country is 26.49 million with an annual growth rate of 1.35 per annum (CBS, 2011 http://www.pops.int/Implementation/NationalImplementationPlans/NIPTransmission/tabid/253/Default.aspx). According to recent state restructuring about 37.63% of the total population is rural; the rate of urbanization is high and rural-urban migration has made the capital of the country densely populated (CBS, 2017 http://www.pops.int/Implementation/NationalImplementationPlans/NIPTransmission/tabid/253/Default.aspx)

Table 1: Industries relevant to PFOS acceptable purposes in Nepal

PFOS Acceptable purposes	Data Source	Comment and Inventory
Photo-imaging (process)	Nepal Printer's Association, Mr. Madhav K.C. (President)	No evidence PFOS use, but significant industry. Plate (Solid Sheet): 10 mtons/printing house/Yr means 20,000 mtons per year; Printing ink: 3 mtons/printing house/Yr means 6000 mtons per year; Washing Chemical: 1000 lt. /printing house/Yr means

		2,000,000 mtons per year; Gum: 1000 lt/Printing house/yr means 2,000,000 mtons per year.
Etching agent for compound semiconductors and ceramic filters (process)		Likely not used.
Aviation hydraulic fluids (production product/mixture, use open application	Nepal Oil Corporation (2015)	No evidence of PFOS use.
Firefighting foam (production product/mixture, use open application)	Civil Aviation Authority Nepal (CAAN); Fire Control Department Mr. Chiranjivi Bhandari, Mr. Arun Bdr. Raut, Mr. Ram Krishna Lamichhane	None of the reported mixtures contain PFAS. Dry chemical powder, mechanical foam, sulfuric acid + soda ash, water + nitrogen gas or carbon dioxide, chemical form (aluminum phosphate + sodium bicarbonate), Halon type (bromo-chlorofluoro- methane), Haletron-1 (bromo-chloro-diflouro-methane) CAAN has 100 Kg of Cartridge, 500 Kg of DCP, 100 Kg of CO_2, 50 Kg Heltron and 60 DCP pressure type. In addition to this, 100 mton of DCP is imported for industrial and organizational use.
Metal plating (hard metal plating) (process open application)	FNCCI, Labor Office and Chamber offices; Mr. Ghanshyam Jha of Aarati Strips Pvt Ltd. (contact no. 9842553055).	No evidence of PFOS use. This industry has been importing Zn-ingot and Pb from India and along with this NaOH, HCl and Fe_2Cl_3 were used to protect the sheets from oxidization (ie. Anti-corrosion); There are about 15-20 industries of medium to large scale in operation, mainly in Biratnagar, Birgunj, Bhairhawa and Nepalgunj.
Metal plating (decorative plating) (process open application)		Metal plating happen in large scale but mostly at the home enterprises basis using a log of chemicals including nitric acid and mercury. So PFOS may not be used in metal plating.
Insecticides for control of red imported fire ants and termites (production product/mixture, use open application)	Pesticide Registration and Management Division (PRMD)	Nepal does not manufacture any pesticide and regulators (PRMD) communicated that PFOS is not among the ingredients of the pesticides used for ant control.
Source: Updated National Implementation Plan (NIP) of Nepal for SC on POPs in Nepal, 2017 http://www.pops.int/Implementation/NationalImplementationPlans/NIPTransmission/tabid/253/Default.aspx		

Table 2: Fire Extinguisher Chemicals and Fire extinguishers imported during (2012/13 to 2017/18) that may include PFAS substances

Items	GHS code	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Preparations for fire extinguishers (charged fire extinguishers) (Kg)	38130000	21580	27007	12480	36970	30124	41313	169474
fire extinguishers (Pcs)	84241000	23483	19606	23189	16933	26524	37163	146898
Sulphonated, nitrated or nitrosated derivatives of hydrocarbon (PFOS-Kg)	29049000	300	2600	15812	1	30780	15074	64567
Saturated acyclic monocarboxylic acids and their derivatives, nes (PFOA -Kg)	29159000	528236	176415	228970	323771	140654	125659	1523705

Table 3. Possible PFOA-containing kitchen and household articles imported in Nepal (2012/13- 2017/18)

Items	GHS code	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Non-stick utensil Table, kitchen or other household articles and parts thereof (Kg)	76151000	2655	962061	162156	1415698	1362140	894337	4799047
Table, kitchen or household articles of cast iron, enameled (Kg)	73239200	89114	103802	606310	225693	117813	134517	1277249
Source: Department of Customs, Import data for different physical years.								

Waste management

Waste management issues have become one of the major environmental challenges for Nepal. Increases in population, an elevated living standard, rapid urbanization and industrialization are the major reasons behind an increase in the generation of solid wastes. Usually, mixed types of wastes are generated and collected (without any segregation) from municipalities, including from industries and health care institutions. Generally, such wastes are openly burned or openly dumped without adequate processing, recycling or recovery in most of the municipalities. Weak enforcement of existing laws on Solid Waste Management (SWM) and less priority given to SWM in institutional, financial and infrastructure development sectors are the major hindrances in the sustainable municipal solid waste management system (ADB, 2013).

Solid Waste Management Act 2011 and Regulations 2013 have empowered and given more responsibility to local level governments for sustainable municipal solid waste management. Currently, private sectors are involved in many municipalities to support in effective solid waste management.

The Ministry of Forest and Environment (MOFE), focal ministry of POPs Convention, has developed various emission and effluent standards to control environmental pollutions from the industries. In the changing context, GON is preparing new Pesticides Act, hazardous waste management regulations and policy. Various recycling plants for paper, plastic, textile, pet bottles, iron metals etc. are established in Nepal and these are expected to contribute in waste reduction and processing. Due to geographical and socio-cultural diversifications, solid waste management practice has become a bit challenging to Nepal, while some of the good efforts on solid waste management practices by various organizations and the new infrastructures developed in the country may lead to positive direction in the management of solid wastes.

Related environmental issues in Nepal

The landscape of Nepal is very prone to natural disasters such as earthquake, flood, landslides, soil erosion and glacial lake outbursts flood (GLOF). Also, the country faces adverse impacts from the use of hazardous chemicals in agriculture and industries.

Major environmental problems of the country are as follows (CBS, 2016):

- Degradation of air quality
- Degradation of drinking water
- Degradation of natural resources
- Lack of solid waste management
- Degradation of surface water quality
- Diminishing of water resources
- Release of toxic pollutants
- Loss of biodiversity
- Impacts of climate change
- Improper land use

Scientific studies on PFAS in Nepal

There are very few studies on PFAS contamination in Nepalese environmental samples. However, three studies have been published that indicate PFAS substances in water, soil, and house dust.

Eriksson U, Karrman A (2015) **World-Wide Indoor Exposure to Polyfluoroalkyl Phosphate Esters (PAPs) and other PFASs in Household Dust**, Environ Sci Technol 49 :14503-14511
PFAS precursor substances such as polyfluorinated phosphate esters (PAPs) were examined along with other PFAS in household dust samples from Canada, the Faroe Islands, Sweden, Greece, Spain, Nepal, Japan, and Australia. Mono-, di-, and triPAPs, including several diPAP homologues, were frequently detected in dust from all countries, revealing an ubiquitous spread in private households from diverse geographic areas, with significant differences between countries. The median levels of monoPAPs and diPAPs ranged from 3.7 ng/g to 1 023 ng/g and 3.6 ng/g to 692 ng/g, respectively, with the lowest levels found in Nepal and the highest in Japan. The levels of PAPs exceeded those of the other PFAS classes. These findings reveal the importance of PAPs as a source of PFAS exposure worldwide.

Tan B, Wang T, Wang P, Luo W, Lu Y, Romesh KY, Giesy JP (2014) **Perfluoroalkyl substances in soils around the Nepali Koshi River: levels, distribution, and mass balance**, Environ Sci Pollut Res Int 21: 9201 - 9211
Perfluoroalkyl substances (PFASs) were analyzed in surface soils along the Koshi River in Nepal, a typical agricultural area with little industrialization and urbanization. Sixteen target PFASs were quantified in soils from a hilly region in central and eastern Nepal, and ten PFAS substances were detected. Concentrations of total PFAS ranged from below the detection limit) to 1.78 ng/g dw. The predominant substances in soils were perfluorooctanoic acid (PFOA) and perfluorobutanesulfonate (PFBS) with concentrations that ranged from nd to 0.26 ng/g dw and nd to 0.38 ng/g dw, respectively. The authors conclude that due to the absence of direct emission of PFAS and slow development of local industry, PFAS in soils most likely originated from long-range atmospheric transport, consumer use, and disposal of PFAS-containing products. Uncontrolled disposal of domestic waste will be a challenge to controlling concentrations of PFASs in Nepal.

Kunacheva C, Fujii S, Tanaka S, Seneviratne ST, Lien NP, Nozoe M, Kimura K, Shivakoti BR, Harada H (2012) **Worldwide surveys of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in water environment in recent years**, Water Sci Technol 66:2764-2771
This study measured PFOS and PFOA in 539 samples from rivers in 15 countries and 41 cities between 2004 to 2010. In total, 539 samples were collected from the rivers in 41 cities. The average concentration of PFOS in each city ranged from not detected to 70.1 ng/L (ppt). PFOS was detected 439 out of 539 samples (81%). The average concentration of PFOA in each city was in the range 0.2-1,630.2 ng/L (ppt). PFOA was found in majority of the samples, 478 out of 539 samples (89%). The industrialized areas showed higher contamination in both PFOS and PFOA concentrations than non-industrialized areas. Industrial activities are some of the major sources of PFCs contamination in rivers. Median levels of PFOS in Nepal were 2.6 ng/L (ppt) – higher than samples measured in China, Malaysia, Laos, Sweden, Sri Lanka, Turkey, and Thailand. The

highest levels were measured in Okinawa, Japan (190 ng/L or ppt) – an island with numerous US military bases. Median levels of PFOA in Nepal were 2.3 n/gL (ppt) – higher than Ireland and Vietnam. The highest level of PFOA contamination was found in Japan (30.7 ng/L or ppt).

Press reports on PFAS

There is no press coverage on PFAS issues in Nepal.

PFAS regulations

As of now, there is no specific legal instrument specific to PFOS, PFOS salts, PFOSF or PFAS related chemicals, but they can be addressed by new Hazardous Substances Management Regulations, a draft of which is under discussion within the ministries.

Regulations that could be applicable to regulation of PFAS include:

- The Constitution of Nepal has ensured the right to environment, health, information etc. as a fundamental right of citizens.
- The Drinking Water Act and the Drinking Water Regulation 2055 (1998)
- Water Resource Act 2049 (1992) & Rules 2050 (1993)
- The Solid Waste Management Act (SWMA) 2068 (2011) and SWM Rules (SWMR)2070 (2013)
- National Urban Water Supply and Sanitation Sector Policy 2009
- Environment Protection Act (EPA) 2053 (1997) & Environment Protection Rules (EPR) 2054 (1997)
- Industrial Enterprises Act (IEA) 2073 (2016)

Recommendations

Recommendations for Stockholm Convention COP9

1. PFOA should be listed in Annex A with no specific exemptions. If exemptions are granted, they should be for specific products and the listing should require labeling new products that contain PFOA so that Parties can fulfill requirements under Article 6 as done previously for HBCD (SC-6/13).

2. Due to the costly, highly polluting nature of firefighting foams, and the availability of cost-effective, technically feasible non-fluorinated alternatives, no specific exemptions should be adopted either for PFOS or PFOA production and/or use in firefighting foams.

3. Specific exemptions or acceptable purposes for the following 11 uses of PFOS should be ended: photo-imaging, photo-resist and anti-reflective coatings for semiconductors; etching agent for compound semiconductors and ceramic filters; aviation hydraulic fluid; certain medical devices; photo masks in semiconductor and LCD industries; hard metal plating; decorative metal plating; electric and electronic parts for some color printers and

color copy machines; insecticides for control of red imported fire ants and termites; and chemically-driven oil production.

4. The following 3 acceptable purposes should be converted into specific exemptions: metal plating (hard metal plating only in closed loop systems); firefighting foams; insect bait for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex*spp. Sulfluramid should be named in the PFOS listing and its use sharply limited to cultivation of specific crops.

National recommendations

1. PFAS monitoring should be conducted to identify hotspots near industrial areas.

2. A complete inventory of PFAS (including PFOA and PFOS) needs to be carried out including in suspected products and process in order to develop a regulatory, institutional framework for sound management of these chemicals in Nepal.

3. For inventory preparation and management of PFAS and other chemicals, interagency coordination is desperately needed in the development and reporting of information.

4. Specific regulations are needed to prohibit PFAS production, use, import, and export. To avoid costly mistakes, PFAS should be banned as a class.

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Annex 1. PFAS toxicity

The Stockholm Convention expert committee (please see Annex 3) evaluated the toxicity characteristics of PFOS in 2007 and PFOA in 2017. Since then, more scientific information has emerged for both these substances along with some of the shorter-chain PFAS aggressively promoted by the industry as substitutes.

Recent research shows the harmful impacts of PFAS

Recent studies have linked PFAS substances to a variety of human health effects: cardiovascular disease, markers of asthma, damage to semen quality, ovarian insufficiency, altered glucose metabolism, lower testosterone levels in male adolescents, association with shorter birth length in girls, elevated blood pressure, abnormal menstruation, lower birth weight in infants, possible increased risk of female infertility due to endometriosis, and decreased lung function in children with asthma.

The chemical industry promoted perfluorohexane sulfonate (PFHxS) as a substitute for PFOS. In 2018, the Stockholm Convention expert committee concluded that it "warrants global action." PFHXS is found in 2 – 4 month-old infants and associated with damage to semen quality. The Stockholm Convention expert committee found that PFHxS has been detected in human blood and breast milk in many regions, and is together with perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and perfluorononanoic acid (PFNA) one of the most frequently detected and predominant PFASs in human blood. The Committee noted that the fetus is exposed to PFHxS via umbilical cord blood and that animal studies show impacts on reproduction, liver function, thyroid hormone levels, and lipid and lipoprotein metabolism.

Studies showing the toxicity, environmental fate, and occurrence of PFAS in current use include:

Perfluorobutanoic acid (PFBA)

- Effects on thyroid and developmental delays in offspring exposed during pregnancy
- Similar toxicity to liver as PFOA
- Associated with damage to semen quality
- Found in home-produced eggs
- Found in the Arctic
- Efficiently trans-located into plants
- Taken up by corn
- Found in fruits and vegetables
- Contaminates fish
- Found in humans in a community with known drinking water contamination
- Found in consumer products

Perfluorobutane sulfonate (PFBS)

- Associated with damage to semen quality
- Disrupts pancreas formation in zebrafish
- Associated with cardiovascular disease in humans
- Associated with markers of asthma in humans

- Increases fatty tissue formation in laboratory studies
- Impairs visual function in fish
- Damages thyroid function in fish in subsequent generations
- Induces reproductive toxicity in animal studies
- Found in 2 – 4 month-old infants
- Found in humans in community with known drinking water contamination
- Found in children
- Found in the Arctic
- Found in consumer products

Perfluorohexanoic acid (PFHxA)

- Similar toxicity to liver as PFOA
- Associated with damage to semen quality
- Negatively associated with testosterone levels in adolescent humans
- Alters zebrafish behavior
- Modulates immune response in vitro
- Contaminated drinking water linked to human body burden
- Alters amphibian embryogenesis
- Exposes the human fetus vis presence in amniotic fluid
- Found in human milk
- Found in house dust
- Found in US wildlife preserves
- Found in the Arctic
- Contaminates fish
- Found in Indo-Pacific humpback dolphins and finless porpoises
- Efficiently trans-located into plants
- Resistant to sewage treatment
- Found in US wastewater treatment plants

Perfluoroheptanoic acid (PFHpA)

- Alters amphibian embryogenesis
- Exposes the human fetus via presence in amniotic fluid
- Found in human milk
- Manufacturing sites, military fire training, and wastewater treatment plants are predictors of pollution
- Use in airport firefighting foams pollutes groundwater, lakes, soils, and fish
- Found in remote mountain snow
- Bio accumulates in plankton
- Contaminates fish
- Efficiently trans located into plants

PFAS in people

Numerous studies show PFAS contamination in people. For example, in one study of 299 infants, PFOS was found in the blood of 297 of them and PFOA was found in all of them.

The Stockholm Convention conducts global monitoring of substances listed in the treaty as part of its effectiveness evaluation. The most recent data is from a series of regional monitoring reports published in 2015.

In Africa, the treaty monitoring study noted that PFOS was detected in mothers' milk from all 11 countries that submitted samples with levels varying from 1 – 34 ppt. The report notes that, *"Assuming that there is no industrial production of PFOS in the region, exposure of humans to PFOS and related chemicals might probably come from different kinds of waste, releases from industrial applications in firefighting and the various consumer products."*

The monitoring report for the Asia-Pacific region notes that only a few countries reported data. The report shows PFOS in air in Fiji, Hong Kong, Japan and in blood including maternal plasma in Japan. PFOS was also measured in marine areas in China, Hong Kong, Japan, Macao and rivers and lakes in Philippines, South Korea, and Thailand.

In Central and Eastern Europe, the Stockholm Convention monitoring report notes that data on water monitoring are scarce and data for the presence of PFOS in human tissues is even more limited.

Stockholm Convention monitoring in Latin America and the Caribbean showed that only Uruguay reported data on PFOS in air and the report notes that at this time (2015) there was no formal monitoring program in the region for determination of PFOS.

In Western Europe and Other States, monitoring data also includes the Arctic where PFOS and PFOA in air were measured. The report notes that phaseouts of PFOS and PFOA are reflected in declining concentrations but that fluorinated substitutes show increasing levels in Arctic air. The study also reveals that of all the measured POPs, PFOS was the predominant substance in human plasma, with the highest level of 470 ppt reported in an Inuit resident of the Arctic.

Recent scientific studies show the widespread presence PFAS in humans. Data include the following:

- Perfluorohexane sulfonate (PFHxS), perfluorononanoate (PFNA), perfluorodecanoate (PFDA), perfluoroundecanoate (PFUnDA), and perfluorotridecanoate (PFTrDA) in human milk in Sweden
- PFOS, PFOA, PFNA, PFDA, PFUnA and PFHxS in maternal sera, placentas, and fetuses.
- PFOS, PFOA, PFHxS, and PFNA in New Zealand adults
- PFOS, PFDoDA, PFUnDA and PFTrDA in pregnant Japanese women
- PFOS, PFOA, PFHxS in >94% of community residents with drinking water contaminated by a former US Air Force base.

- 10 long-chain PFAS in California women.
- PFOS< PFOA< PFHxS, PFNA, PFUnDA, PFHpS found in maternal plasma in Norway.
- PFAS in amniotic fluid in Denmark.
- Prenatal exposure to PFOS, PFHxS, PFHpS, PFNA, and PDFA in Denmark.
- Prenatal exposure to PFBS, PFHxS, PFUA in China.
- Six PFAS in middle-aged US women.
- PFNA, PFDA, PFUnDA, PFHxS, PFOA, and PFOS in more than 99% of sampled pregnant Swedish women.
- PFAS in maternal and cord blood in mothers exposed to the US World Trade Center disaster during pregnancy.
- PFOA, PFOS, PFNA, PFHxS in cord blood of Slovak infants.
- PFOS, PFOS and 6:2 CL-PFESA in cerebrospinal fluid in China indicating ability to cross the blood-CSF barrier.
- PFOS, PFOA, PFNA, and PFHxS in children.
- PFOA, PFOS< PFNA, and PFHxS in pregnant US women.
- PFOS< PFOA< PFHxS and PFNA in maternal serum in the UK.
- PFOA, PFOS, and PFHxS in Chinese women.
- PFOA and PFNA in US children.
- PFAS in Alaska Natives.
- PFHxS, PFOA< PFOA, PFNA, PFDA, PFUdA, PFDoA, and PFTrDA in >85% of sampled pregnant women in China.
- PFAS in pregnant Chinese women.

Manufacturers knew PFAS were harmful

Recently obtained documents indicate that the original manufacturers of PFOS and PFOA knew about the harmful characteristics of both substances decades ago.

A lawsuit filed by the US State of Minnesota against 3M produced internal company documents that demonstrated that the company knew PFOS and PFOA were accumulating in people for more than 40 years. 3M had previously withheld required documents from US regulators which resulted in a USD$1.5 million fine in 2006. In 1975, university researchers found a fluorinated substance in human blood and 3M confirmed that it was PFOS. Subsequent company testing found PFOS levels in 3M personnel at levels 50 – 1000 times higher than normal levels. In 1978, tests on monkeys feed PFOS resulted in all the animals dying and those given PFOA developed lesions on their spleen, lymph nodes, and bone marrow, all relevant to a functioning immune system. By 1989, the company knew that PFOS suppressed the immune system, caused tumors in animals, and that rates of cancers of the digestive organs and prostate were elevated in its own workers. The company proceeded to produce the substance anyway.

Internal company documents reveal that DuPont knew decades ago that PFOA affected the livers of dogs and humans, encouraged the growth of testicular tumors in rats, and appeared to result in endocrine disorders and kidney cancer in workers. In 1978, the company documented immune-toxicity and other adverse effects in tests on monkeys exposed to PFOA and PFOS. By 1984, DuPont knew that PFOA was toxic, didn't break down, accumulated in blood, transferred from mothers to the fetus, and polluted drinking water supplies. DuPont decided to keep producing it anyway as it became incorporated into a multitude of products and processes. The company's real attitude about the consequences of PFOA production is revealed in its internal documents as "the material 3M sells us that we poop to the river and into drinking water."

DuPont was fully aware of PFOA's hazards, but a study of the company's decision-making processes noted that DuPont made a calculated, rational decision to pollute anyway. The authors estimate that for DuPont, "it was value-maximizing to pollute if the probability of getting caught was less than 19%." In reality the probability was much less than that and now communities and governments bear the burden of that private sector decision.

Annex 2. The high cost of PFAS cleanup

PFAS manufacturing and use in a multitude of products such as firefighting foams has resulted in widespread pollution – especially in water due to the solubility of PFAS substances. PFAS-contaminated sites have been identified in Australia, Canada, China, Germany, Italy, Japan, Netherlands, New Zealand, South Korea, Sweden, and the US, including a large number of military bases that contribute to 172 PFAS contamination sites in 40 states.In 2018, the US State of Minnesota entered into an agreement with 3M for the company to pay the state USD$850 million for costs associated with cleanup of PFAS including PFHxS due to manufacturing and releases by the company.

Clean up of PFAS pollution is difficult and costly. According to the Polluter Pays Principle, and sound economic policy, these types of external costs should not be borne by taxpayers,the state or national treasury, or by any other third party. Rather, these costs should be internalized within producer industries to avoid market distortion. As noted by UN Environment in 2012, "The vast majority of human health costs linked to chemicals production, consumption and disposal are not borne by chemicals producers, or shared down the value-chain. Uncompensated harms to human health and the environment are market failures that need correction."

Examples of estimated and actual cleanup costs for PFAS pollution include:

- Recent US government agency estimates for the cost PFAS clean-ups and associated monitoring due to use of firefighting foams at US military bases are more than USD$2 billion.There are also expensive clean up costs and estimates in a variety of US states including Alaska, New Jersey, New York (see also here and here), Vermont, Virginia, and Washington.
- The World Bank estimates that if just 20% of fluorinated firefighting foam in China is used for training or fire extinguishing, remediation costs would exceed USD$800 million.
- Remediation of PFAS-containing firefighting foam at the Düsseldorf Airport in Germany will take years or even decades. Cleanup costs cited by the European Chemicals Agency exceed €100 million. There are additional documented remediation costs due to PFAS pollution in Germany – see here, here, and here.
- Clean up due to use of 3M's "Light Water" firefighting foam containing PFOS and PFHxS at 18 military bases in Australia is estimated to cost hundreds of millions of dollars. The cleanup of just a single firefighting training college in Australia is estimated to cost AUS$80 million.
- To clean up groundwater polluted by PFAS around fire fighting areas in Norway costs €3.5-5.5 million per training site.
- Firefighting training sites are the main sources of PFAS pollution in Sweden leading to €1 million in annual costs for charcoal filtering of water in Uppsala and a new water supply in Ronne costing €3 million. Extrapolated estimates for advanced cleaning of all waste water treatment plants in Sweden would only moderately remove fluorinated compounds but still cost USD$230 million per year.
- New Zealand has budgeted NZE$1 million to investigate cleanup of PFAS associated with firefighting foam use by military bases.

Annex 3. PFAS and the Stockholm Convention

The Stockholm Convention objective is to protect human health and the environment from persistent organic pollutants. Persistent organic pollutants (POPs) are a class of highly hazardous chemical pollutants that are recognized as a serious, global threat to human health and to ecosystems. Substances can be added to the Stockholm Convention after evaluation and recommendation by the POPs Review Committee (POPRC). Nepal became a Party to the treaty in 2006.

PFOS

Governments added PFOS to the treaty list at the 4th Conference of the Parties in 2009 and subsequently adopted a series of guidance documents on PFOS alternatives.

Specific exemptions:
http://chm.pops.int/Implementation/Exemptions/SpecificExemptions/ChemicalslistedinAnnexBRoSE/PFOSRoSE/tabid/4644/Default.aspx

Acceptable purposes:
http://chm.pops.int/Implementation/Exemptions/AcceptablePurposes/AcceptablePurposesPFOSandPFOSF/tabid/794/Default.aspx

According to updated NIP 2017 submitted by the Government of Nepal to the Convention Secretariat clearly mentioned that though no information pertaining to import and use of PFOS, PFOS salts, PFOSF or PFOS related chemicals could be found during inventory preparation, it cannot be excluded that PFOS containing mixtures might still be imported to Nepal for certain use. It is therefore necessary for Nepal to complete its inventory.

When PFOS was listed in Annex B of the treaty in 2009, a very large number of loopholes accompanied its listing that permitted continued production and use. At COP9 in April/May 2019, Parties will determine if these loopholes are still needed or if some can be ended. The decision will focus on 6 time-limited ones (specific exemptions) and 8 time-unlimited ones (known as acceptable purposes). The POPRC recommended the following changes to the PFOS listing in the Convention:

End loopholes for 11 PFOS uses: photo-imaging, photo-resist and anti-reflective coatings for semiconductors; etching agent for compound semiconductors and ceramic filters; aviation hydraulic fluid; certain medical devices; photo masks in semiconductor and LCD industries; hard metal plating; decorative metal plating; electric and electronic parts for some color printers and color copy machines; insecticides for control of red imported fire ants and termites; and chemically-driven oil production.

Convert two time-unlimited exemptions to time-limited exemptions: metal plating (hard metal plating only in closed loop systems) and firefighting foams. This gets the clock running on ending these uses in five years. On the firefighting foams, the Committee recommended stopping production and only allowing use for class B fires (ones involving solvents, oil etc.) and only in installed systems. The Committee also noted that, *"a transition to the use of short-chain per- and* *polyfluoroalkyl substances (PFASs) for dispersive applications such as fire-fighting foams is not a suitable option from an environmental and human health point of view…"* This is extremely important since the fluorinated alternatives are persistent, toxic and readily pollute drinking water.

Continue time-unlimited exemption for one use: insect bait for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex* spp. This vaguely-worded listing actually refers to a pesticide called sulfluramid that degrades to PFOS. The POPRC recommended naming sulfluramid in the treaty under the PFOS listing and narrowing its use to agriculture.

IPEN recommendations for PFOS

Specific exemptions or acceptable purposes for the following 11 uses of PFOS should be ended: photo-imaging, photo-resist and anti-reflective coatings for semiconductors; etching agent for compound semiconductors and ceramic filters; aviation hydraulic fluid; certain medical devices; photo masks in semiconductor and LCD industries; hard metal plating; decorative metal plating; electric and electronic parts for some color printers and color copy machines; insecticides for control of red imported fire ants and termites; and chemically-driven oil production.

The following 3 acceptable purposes should be converted into specific exemptions: metal plating (hard metal plating only in closed loop systems); firefighting foams; insect bait for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex* spp. Sulfluramid should be named in the PFOS listing and its use sharply limited to cultivation of specific crops .

Due to the costly, highly polluting nature of firefighting foams, and the availability of technically feasible, high-performing non-fluorinated alternatives, no exemption should be granted for this use.

PFOA

PFOA is extremely persistent and does not degrade under relevant environmental conditions. It bioaccumulates in air-breathing land and marine mammals, including humans.PFOA is found in water, snow, air, sediment and biota at remote locations including the Arctic. In 2017, the Stockholm Convention POPs Review Committee noted the link between PFOA and serious illnesses in humans, including diagnosed high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer and pregnancy-induced hypertension. PFOA is transferred to the fetus through the placenta and to infants via breast milk. PFOA-related compounds such as fluorotelomer alcohols, fluoropolymers and fluorotelomer-based polymers must be included in actions designed to eliminate PFOA releases since they can degrade to PFOA.

In 2018, the POPRC recommended that governments list PFOA and related substances in Annex A of the Stockholm Convention for global elimination.

Ten time-limited exemptions accompany the PFOA listing recommendation, however, many of these are not justified.

Proposed PFOA Exemption	**Comment**

5 years 3 exemptions connected to semiconductor manufacturing (equipment or plant infrastructure, legacy equipment, photo-lithography, etch process)	Alternatives without PFOS or PFOA are available for photolithography and etch processes. For example, IBM eliminated both in 2010. The other proposals are not sufficiently defined.
Photographic coatings applied to films	Obsolete use of PFOA replaced by digital imaging, including in developing and transition countries.
Textiles for oil and water repellency for workers	Proposal relies on industry claims and does not state what specific products the exemption would cover or how worker protection can be achieved without relying on a toxic chemical-impregnated textile.
Invasive medical devices	Alternative medical devices made without PFOA have passed all regulatory requirements, are available on the market, and in use.
Implantable medical devices	Alternative medical devices made without PFOA have passed all regulatory requirements, are available on the market, and in use.
Firefighting foams	Cost-effective non-fluorinated alternatives are in use at major airports and military installations and perform as well as PFAS-containing foams.
10 years For manufacture of semiconductor or related electronic devices; refurbishment parts containing fluoropolymers and/or fluoroelastomers with PFOA for legacy equipment or legacy refurbishment parts	See above for manufacturing. Legacy equipment proposal is not specific and include thousands of unnamed parts. Retrofitting with parts that do not contain PFOA should be utilized, instead of continuing PFOA production and use.
Until 2036 To use PFOI (a PFOA-related substance) to make PFOB for producing pharmaceutical	In 2015, more than 100 governments agreed that environmentally persistent pharmaceutical products are an emerging

products *“with a review of continued need for exemptions.”*	policy issue of global concern in the SAICM process. A global exemption should not be adopted on behalf of a single company (Daikin) and exemptions for environmentally persistent pharmaceutical products should not be recommended.

IPEN recommendations for PFOA

PFOA should be listed in Annex A with no specific exemptions. If exemptions are granted, they should be for specific products and the listing should require labeling new products that contain PFOA so that Parties can fulfill requirements under Article 6 as done previously for HBCD (SC-6/13). In addition, due to the costly, highly polluting nature of firefighting foams, and the availability of technically feasible, high-performing non-fluorinated alternatives, no exemption should be granted for this use.

PFHxS

PFHxS and related compounds are persistent in water, soil and sediment and unlikely to undergo degradation in the environment including hydrolysis, aqueous photolysis or under anaerobic conditions. PFHxS biomagnification factors (BMF) greater than 1 have been observed in food chains including Arctic bird/fish, Arctic polar bear/ringed seal, dolphin/fish, and fish/zoo plankton among others, indicating bioaccumulation. PFHxS has the longest half-life in humans determined for any PFAS. PFHxS undergoes long-range transport and is found in Arctic air, sediment, snow, ice, soil, sediment and biota (including humans) and in Antarctic biota and snow. *In vivo* and epidemiological studies show that PFHxS negatively affects liver function, thyroid, and the developing immune system resulting in reduced effects of vaccines and higher incidences of infections and asthma in children. A significant association between PFHxS exposure and breast cancer has been found in Greenlandic Inuit women. PFHxS is widely found in breast milk and is one of the most frequently detected and predominant PFAS in human blood, including maternal and infant cord blood. In September 2018, the POPRC determined that PFHxS “warrants global action” and moved the substance to the third and final evaluation during 2018 – 2019.

PFAS use in firefighting foams

There are many uses of PFAS, but one of the most highly polluting is in firefighting foams. This pollution occurs where the foam is used and quickly contaminates water and moves. Airports and military bases are common sources of PFAS pollution.

PFOS and PFOA were the original components in firefighting foams, but after regulatory pressure in the US, many companies switched to shorter-chain substances such as PFHxS, PFBA, PFBS, PFHxA, and PFHpA. These substances also are persistent and have hazardous properties. Some are found in the Arctic, suggesting ability to undergo long-range transport.

Recently, IPEN assembled a group of fire safety experts who produced a detailed report on issues involving firefighting foams and the technical feasibility of fluorine-free firefighting foams. Safer cost competitive non-fluorinated alternatives to PFAS in firefighting foams have been adopted by major airports, including Auckland, Copenhagen, Dubai, Dortmund, Stuttgart, London Heathrow, Manchester, and all 27 major airports in Australia.

In September 2018, the POPRC recommended severe restrictions on the use of PFOS and PFOA in firefighting foams. In addition, the Committee also made an extremely important recommendation **not** to use the fluorinated alternatives to PFOA and PFOS, *"due to their persistency and mobility as well as potential negative environmental, health and socioeconomic impacts."*

The recommended restrictions on firefighting foams containing PFOA, PFOA-related substances, or PFOS include:

- No production.
- Use for 5 years only for liquid fuel vapor suppression and liquid fuel fires (Class B fires) already in installed systems.
- No import or export, except for environmentally-sound disposal.
- No use for training or testing purposes.
- By 2022, restrict use to sites where all releases can be contained.
- Ensure that all firewater, wastewater, run-off, foam and other wastes are managed in accordance with the treaty.

IPEN recommendations on PFAS use firefighting foams

Due to the costly, highly polluting nature of firefighting foams, and the availability of technically feasible, high-performing alternatives, no exemption should be granted for this use. IPEN supports the POPRC recommendation that fluorinated alternatives to PFOA and PFOS should not be used.