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Sustainable Stormwater and Wastewater Management

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Environmental Geochemistry of Persistent Toxic Substances – with a Focus on Food Contamination

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-Research Grants Council of Hong Kong
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PERSISTENT TOXIC SUBSTANCES (PTS)

(1) Persistent Organic Pollutants (POPs): DDT, PCB, Dioxins

(2) Toxic Metal/Metalloids: As, Cd, Cu, Hg, Pb, Zn

(3) Emerging Chemicals of Concern (ECC)

Flame Retardants, Pharmaceuticals & Personal Care Products (PPCP), Endocrine Disruptors (Modulating Chemicals), Nanoparticles, Perfluorooctanesulfonate (PFOS), Perfluorinated compounds (PFCs), etc

PTS TIMELINE (1870-2013)

1850

1874 DDT first synthesized
1881 PCBs synthesized
1889 First reports of skin disease linked to POPs

1900

1929 Industrial scale production of PCBs
1948 Paul Muller receives Nobel Prize

1950

1959 Peak of DDT use in the US
1962 Rachel Carson's *Silent Spring* is published
1966 Wildlife damage reported
1972 US bans DDT
1979 US bans manufacture of PCBs
1996 Theo Colburn's *Our Stolen Future* is published
1989 Basel Convention – transboundary movement of hazardous wastes & disposal
1998 Rotterdam Convention – Prior Informed Consent (PIC) Procedure for certain hazardous chemicals & pesticides in international trade

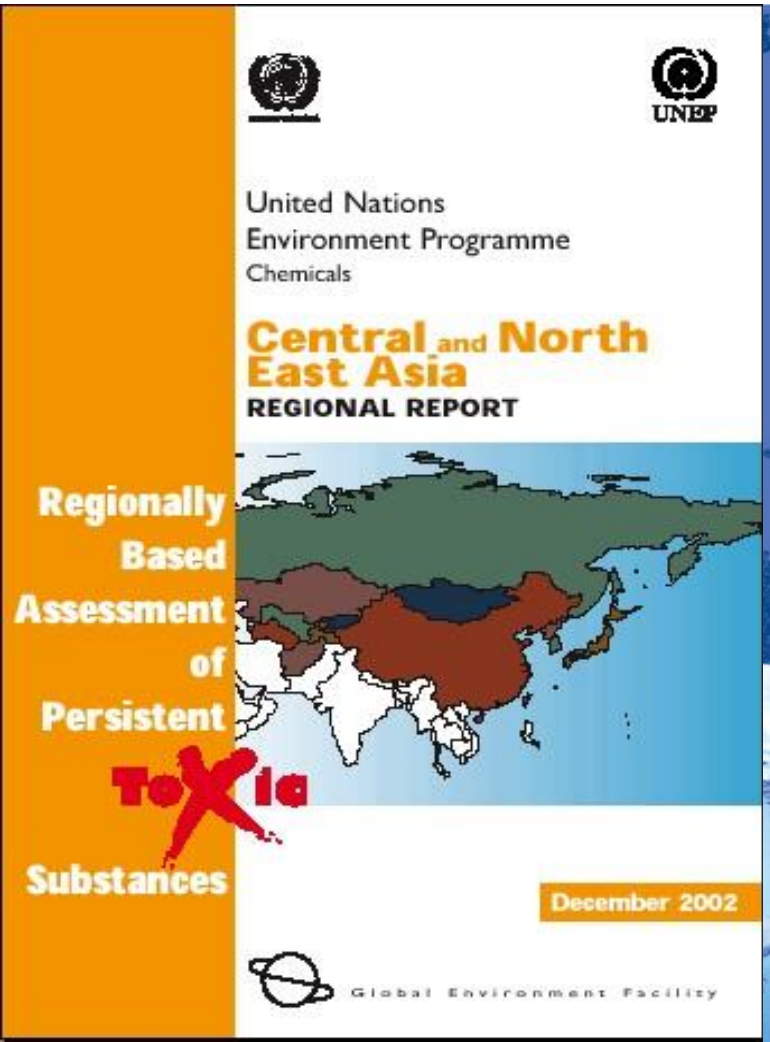
2000

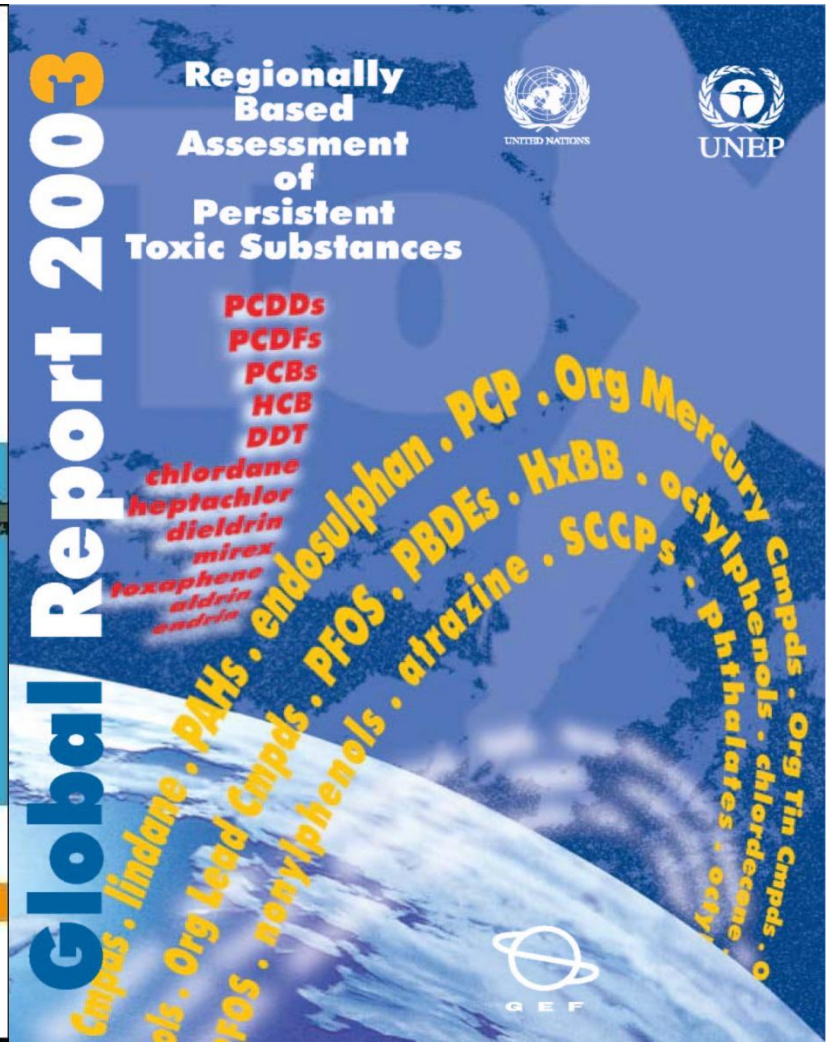
2001 Stockholm Convention on POPs
2006 Restriction of Use of Certain Hazardous Substances in EEE
2007 Waste Electrical & Electronic Equipment – design for reuse, recycle & recover
2013 Global Treaty on Mercury Pollution

Regionally Based Assessment of Persistent Toxic Substances (PTS) 2000-2003

UNEP-Chemicals & GEF (Global Environmental Facility)

http://www.chem.unep.ch/pts





The Stockholm Convention on

Pesticides	Industrial Chemicals	Unintended By-products
Aldrin	PCBs	Dioxins
Chlordane	Hexachlorobenzene	Furans
DDT		
Dieldrin		
Endrin		
Heptachlor		
Hexachlorobenzene		
Mirex		
Toxaphene		

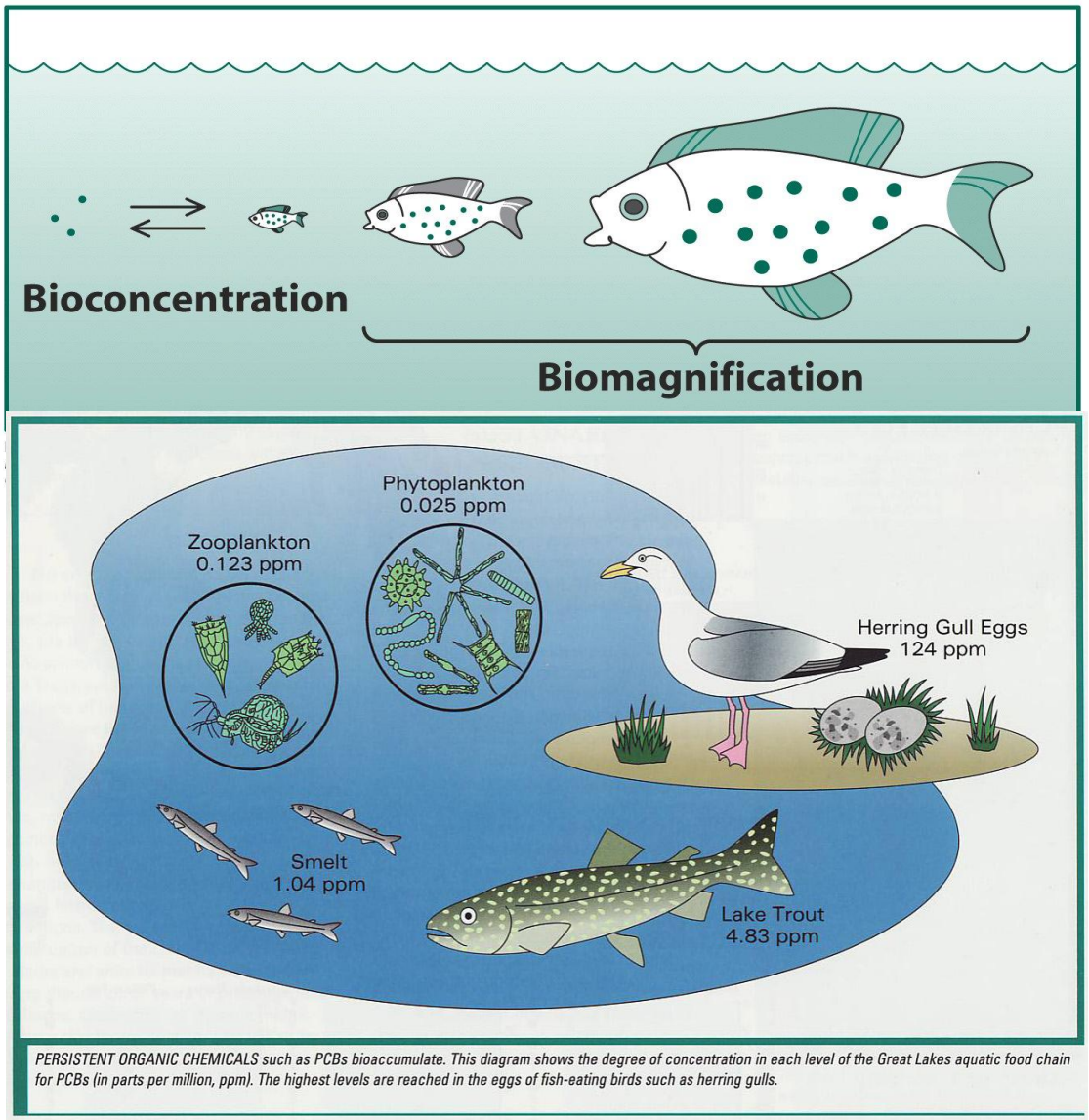
- Adopted in 2001
- Entered into force 17 May 2004
- To date it has 166 Parties

10 New POPs

1. Pentabromodiphenyl ether (PBDE)
2. Chlordecone
3. Hexabromobiphenyl
4. Lindane
5. Perfluorooctane sulfonate
6. Octabromodiphenyl ether (PBDE)
7. Pentachlorobenzene
8. Short-chained chlorinated paraffins
9. Alpha hexachlorocyclohexane
10. Beta hexachlorocyclohexane

Most POPs are covered by all 3 conventions.
Many pesticides are subject to the 3 conventions.

Persistent Toxic Substances Toxic Pathways



PERSISTENT ORGANIC CHEMICALS such as PCBs bioaccumulate. This diagram shows the degree of concentration in each level of the Great Lakes aquatic food chain for PCBs (in parts per million, ppm). The highest levels are reached in the eggs of fish-eating birds such as herring gulls.

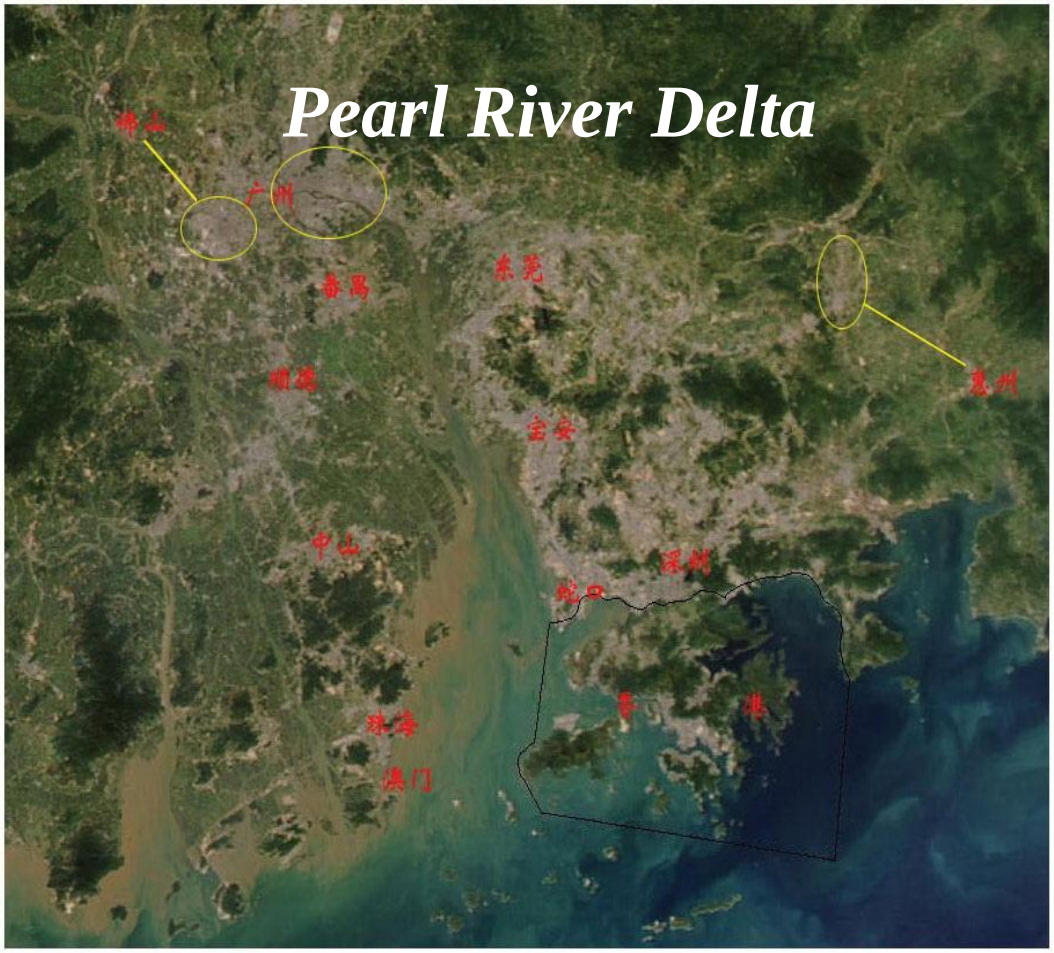
One pathway is biomagnification: accumulation or increase in the concentration of a substance in living tissue as it moves through a food web--also known as bioaccumulation.

Cheng Z, Liang P, Shao DD, Wu SC, …, Wong MH (2011) Hg biomagnification in aquaculture pond ecosystem in PRD. *Arch Environ Contam Toxicol* 61

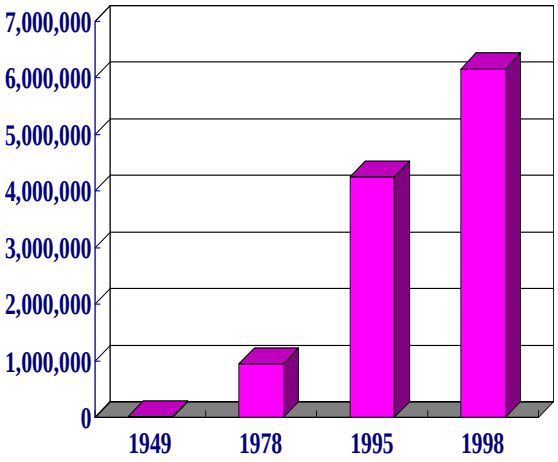
THE PEARL DELTA – SOUTH CHINA

- PRD is the pioneer of reforms & the opening-up policy
- The most developed region in China
- PRD's GDP surpassed Singapore in 1998, HK in 2003 & Taiwan in 2007
- World Centre for electrical/electronic products

PRD: 9 cities in Guangdong Province: Guangzhou, Shenzhen, etc. **Greater PRD**: 9 cities + **HK & Macau**.



Cancer Villages in China



Gross output of 10 main non-ferrous metals (tonne)

- A total **of 459 cancer villages** across 29 of China's 31 provincial units (except Tibet & Qinghai).
- **At least an 80% increase in cancer deaths,** since the start of economic reforms (30 years ago).
- **Death rates** near chemical, pharmaceutical or power plants **exceed the national average**

Guangdong Province

- 4 economic regions: Pearl River Delta, East, West, & North (Mountainous regions - worst in China).
- **Iron & copper sulfide strip mining** – **Cd, Pb & other toxic metals**.
- **From 1978 to 2005, over 250** (around 50 yrs old) **died of cancer** in Shangba village (total 3,329 in 2009) (Zhang & Hong, 2008), near the mines
-

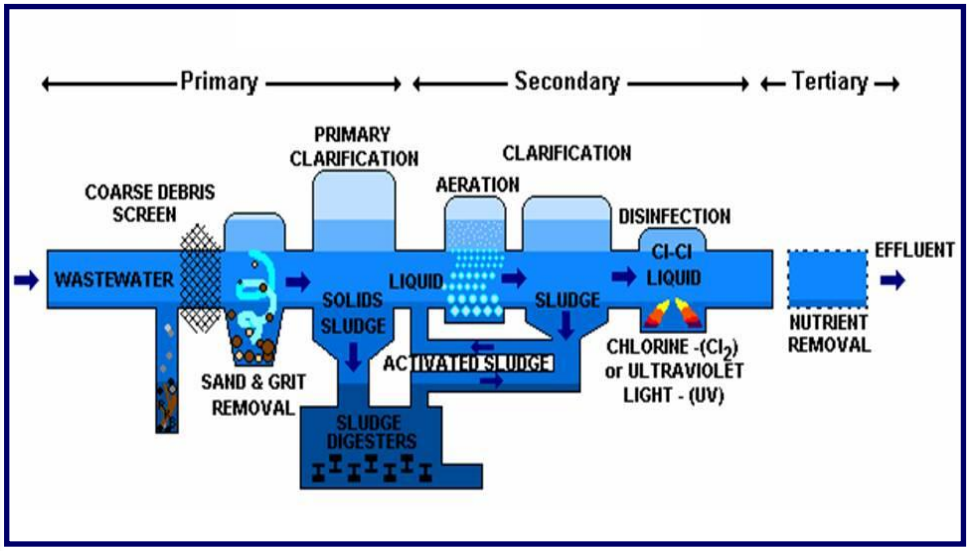
PTS IN DENSELY POPULATED URBAN CENTERS

- PTS are finding their ways to Sewage Treatment Works (STW) from urban centers
- They could not be removed completely by STW
- They will enter into food chains (terrestrial & aquatic)

Sources of Persistent Toxic Substances & Emerging Contaminants

Agriculture

Open burning



Flushed down to toilets

Consumer products

Pathways to Nature

- **Directly into the sewage system**
  - **Excreted medicine**
    - -Unmetabolized parent compounds
    - -Partially metabolized compounds
    - -Altered compounds
  - **Unused or unwanted medicines**
  - **Manufacturing metabolites**
- **Aquatic environment**
- **Landfill leachate**

Removal Efficiency of Toxic Chemicals by Sewage Treatment Works (STW)

Consultancy Project

Major objective:

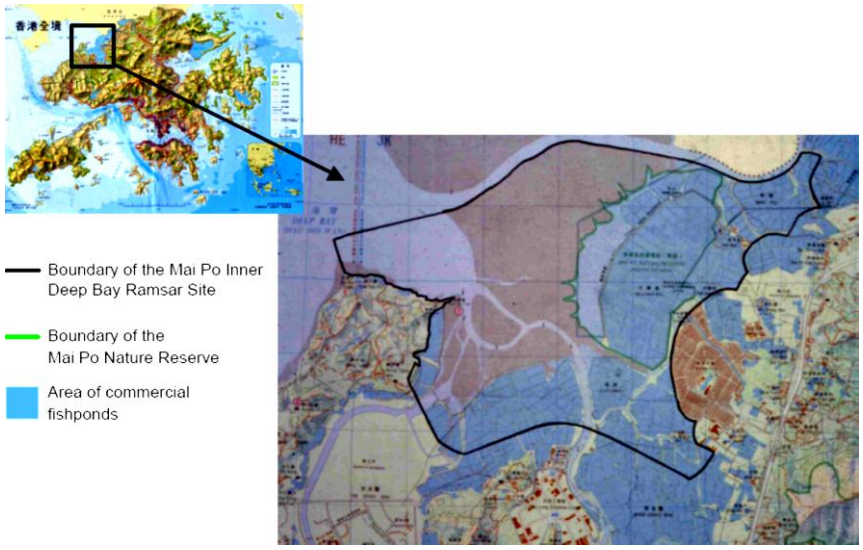
Drainage Services Department
The Government of the Hong Kong Special Administrative Region

To evaluate the removal efficiency of two types of STW on the following toxic chemicals:

- **Heavy metals/metalloids (**As, Cd, Ni, Sb, Sn, Zn, Cu, Cr, Pb, total-Hg, & methyl-Hg**),**
- **Persistent toxic substances** (DDTs, PBDEs, PCBs, PAHs)**,**
- **Emerging chemicals of concern** (bisphenol A, PFOA/PFOS)**,**
- **Antibiotics** (tetracycline, ciprofloxacin and erythromycin),
- **Hormones** (estradiol, estriol, estrone, ethinylestradiol, testosterone)**.**

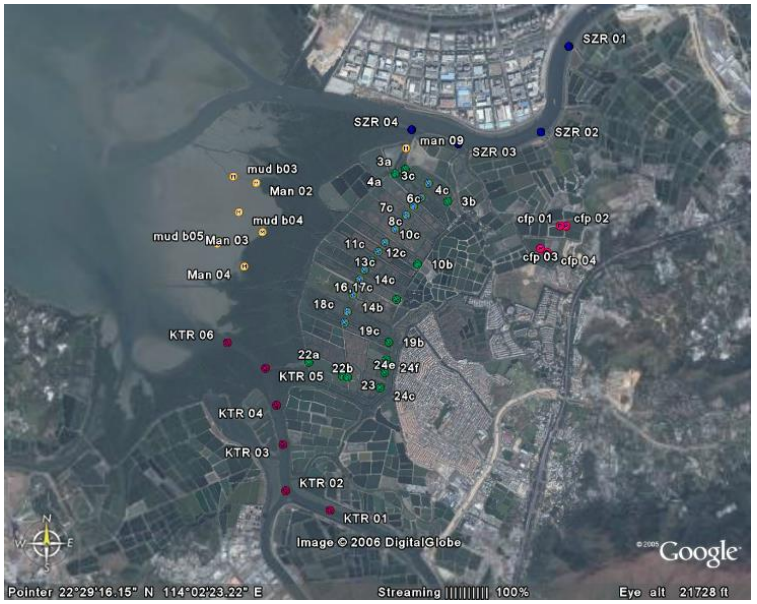
Ecological & Health Risk Assessments of Major PTS in Deep Bay Area, in Relation to Their Removal Efficiency in Yuen Long and Shek Wu Hui Sewage Treatment Works

DRAINAGE SERVICES DEPARTMENT



1. Some PTS contained in sewage effluent discharged from 2 local sewage treatment works (STWs) may affect the water & sediment quality of this ecological important coastal zone, which subsequent impose ecological & health effects;

2. Whether the 2 STWs are able to remove the PTS, our previous study indicated another 2 STWs (Shatin & Stonecutters Island) had low removal efficiencies of some PTS

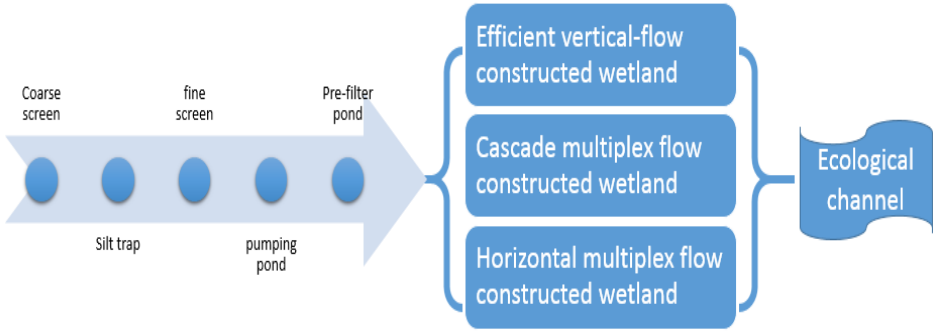


A constructed wetland for removing pollutants from combined village sewage

DRAINAGE SERVICES DEPARTMENT

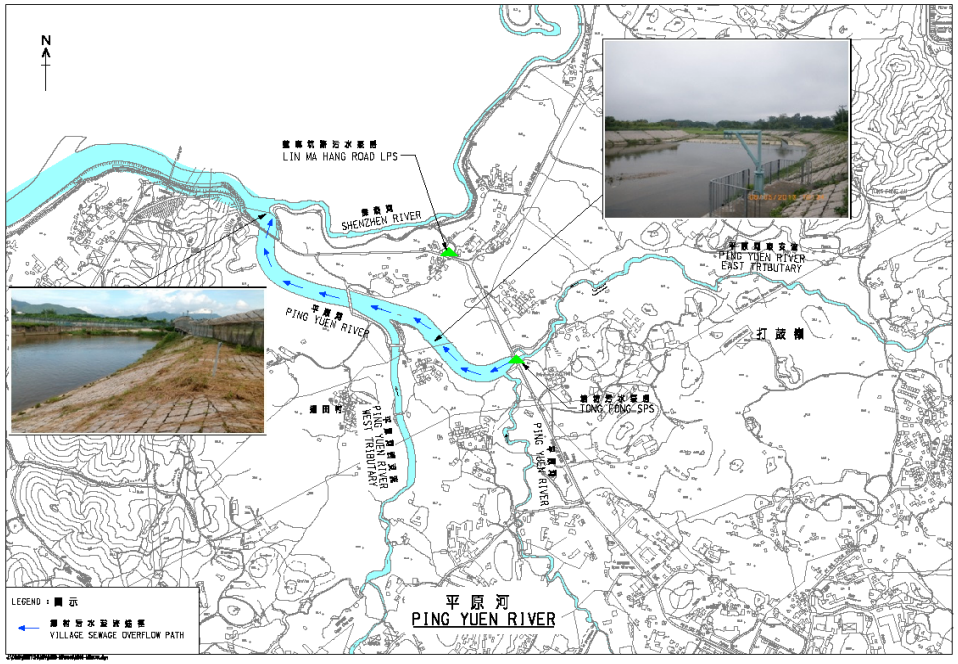
(1) CHEER of HKIEd; (2) CIES of HKBU
(3) SZ Key Lab Marine Biores & Eco-Environ Sci, Shenzhen Univ.
(4) SZ Biyuan Environ Protect Tech Co. Ltd

1. Design & construct a wetland



2. Select wetland plants

- Erosion control of embankments, under dry & wet seasons
- Purify contaminants: plant nutrients (N & P), heavy metals (Cd, Cu, Pb, Zn, etc), BOD, SS in the incoming wastewate;
- Improve the scenic value of the channels
- Provide habitats for wildlife (dragonflies, snails, fish, birds, etc)



EXPOSURE PATHWAYS OF PTS

- Inhalation
- Ingestion (water, food)
- Dermal contact

FOOD SAFETY AND HEALTH RISK ASSESSMENTS

EXPOSURE

-Nearly 18 million people in Bangladesh are drinking water containing more than 200 µg/L As.
-The drinking water provisional guideline value suggested by WHO is 10 µg/L (Anaward et al. 2002)

-Inhalation is a potential risk, particularly for industrial exposures related to smelting or generation of sawdust from pressure-treated wood.
-Wood & coal smoke are also of concern in domestic settings (Finkelman et al, 1999).

-Chili peppers roasted over coal containing up to 35,000 ppm As typically adsorbs 500 ppm As, causing poisoning in Guizhou Province, China (Chou & De Rosa, 2003).

Children are at particular risk for As exposure from soil ingestion. (Chou & De Rosa, 2003).

Shellfish are the largest dietary source for As (more organic).

Risk Assessments on Human Health

Risk assessment via ingestion exposure pathway (USEPA, 2000).

1

Non-cancer risk

1. Mutagenicity
2. Developmental toxicity
3. Neurotoxicity
4. Reproductive toxicity

2 **EDI = (Concentration × Consumption rate)/ BW**

Where,

EDI=Estimated daily intake (mg/kg/day)

Concentration=Contaminant concentration (mg/kg)

Consumption rate= Consumption of fish per day (kg/day)

BW=Body weight (kg)

3

$$\frac{\text{Estimated daily intake (mg/kg/day)}}{\text{Reference Dose (mg/kg/day)}} = \textbf{Hazard Quotient (HQ)}$$

4

HQ ≤ 1 = **Unlikely adverse effect to** human health

HQ >1 = **Likely adverse effects** to human health

Cancer risk = LTEDI X SF

where, LTEDI= Life-time Estimated daily intake (mg/kg/day)

SF = Slope factor $(mg/kg/day)^{-1}$

Lifetime cancer risk (NYS DOH, 2007)	
< 1/1,000,000	Very low
> 1/1,000,000 to <1/10,000	Low
1/10,000 to 1/1,000	Moderate
1/1,000 to < 1/10	High
> 1/10	Very high

Food safety

Food safety is any **action** & **policy** which ensure food is safe, in the entire food chain (**production** to **consumption)** (WHO, 2013).

Key global food safety concerns include:

1. Spread of microbiological hazards (including such bacteria as *Salmonella* or *Escherichia coli*);
2. **Chemical food contaminants**;
3. Assessments of new food technologies (such as genetically modified (GM) food.

Case Study 1: Arsenic Uptake by Rice

FAO :: Newsroom :: News stories :: 2007 :: Arsenic threat in r...

FAONewsroom

Food and Agriculture Organization of the United Nations
helping to build a world without hunger

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  - 2005
  - 2004
  - 2003
  - 2002
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- Video
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- Photography
- Media contacts
- Tools for journalists

Arsenic threat in rice

Reducing arsenic levels in rice through improved irrigation practices

19 December 2007, Rome – High levels of arsenic in rice could be reduced by applying improved irrigation management practices in Asia, FAO said today in a new report entitled *Remediation of Arsenic for Agriculture Sustainability, Food Security and Health in Bangladesh*.

Studies have shown that high concentrations of arsenic in soil and irrigation water often lead to high levels of arsenic in crops and are posing an increased food safety risk. At present, twelve countries in Asia have reported high arsenic levels in their groundwater resources.

"The problem of high arsenic levels in crops, particularly rice, needs to be urgently addressed by promoting better irrigation and agricultural practices that could reduce arsenic contamination significantly," said Sasha Koo-Oshima, FAO water quality and environment officer.

"Arsenic-contaminated rice could aggravate human he
when consumed with arsenic-laden drinking water. The
widespread addition of arsenic to soils, for example in
Bangladesh, is degrading soil quality and causing toxic
rice. Arsenic contamination is threatening food product
food security and food quality," she noted.

Entering the food chain

Arsenic enters the food chain mainly through crops ab
contaminated irrigation water. Millions of shallow tube
have been installed throughout Asia over the last three
decades pumping water from contaminated shallow
groundwater aquifers.

Contact:

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Planting rice in raised beds could lower arsenic levels.

--**Rice** is the main **staple food** of millions , a source of micronutrients & **toxic elements.**

--Paddy soils are contaminated by **As & Cd** through irrigation water (e.g., sewage), fertilizer, & mine tailings.

--**As** is immobilized under oxidizing conditions & solubilized under reducing conditions, & vice-versa in **Cd**.

-**As:** Blackfoot diseases.
-**Cd:** *Itai-itai*, renal tubular dysfunction

Arsenic Speciation – Uptake by Rice

-As forms inorganic As(V) & As(III) & organic complexes (MMA & DMA)

-Arsenate As(V): the main species in aerobic soils, uptake in plants is mainly through P transporters (Asher & Reay, 1979).

-Arsenite As(III): dominates in anaerobic soils (flooded paddy soils)

-Monomethylarsonic acid (MMA), dimethylarsinic acid (DMA): less toxic

- Rice contributed a significant As uptake in Cambodian people

-**Health risk.. As intake drinking pathway** -Phan K, Sthiannopkao S, … Wong MH 2010. *Water Res 44*

-**Groundwater & health risk of residents** -Phan K, …, Wong MH, Hashim JH,.. 2013. *Environ Pollut 182*

-**Hair As & arsenicosis in Cambodia** -Hashim JH, …, Phan K, Wong MH, … 2013 *Sci Total Env 463*

- Rice genotypes with lower As uptake (ROL & Fe plaque)

-**Al accumulation/speciation & genotypes** -Wu C, Ye ZH, …, Zhu YG, Wong MH 2011. *J Exp Bot* 62

-**ROL affects As speciation in rice** -Wu C, Ye ZH, .. Wu SC, .. Zhu YG, Wong MH 2012. *J Exp Bot 63*

- AMF & As uptake by rice

-**Uptake of As in lowland/upland rice, AMF** -Li H, Ye ZH, …, Wu SC, Wong MH 2011**.** *J Hazard Mater 194*

-**AMF affect As in rice with different ROL** -Li H, ..Ye ZH,…., Wu SC, Wong MH 2013. *J Hazard Mater 262*

Case Study 2: Fluoride & Aluminum Uptake by Tea

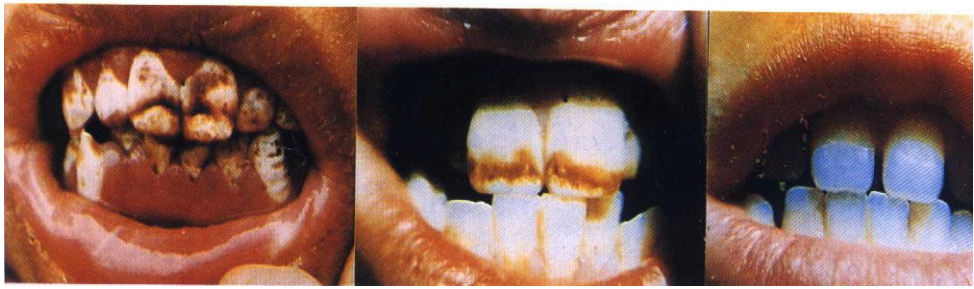
Leaf tea

Oolong Green Pureh Black

Brick tea

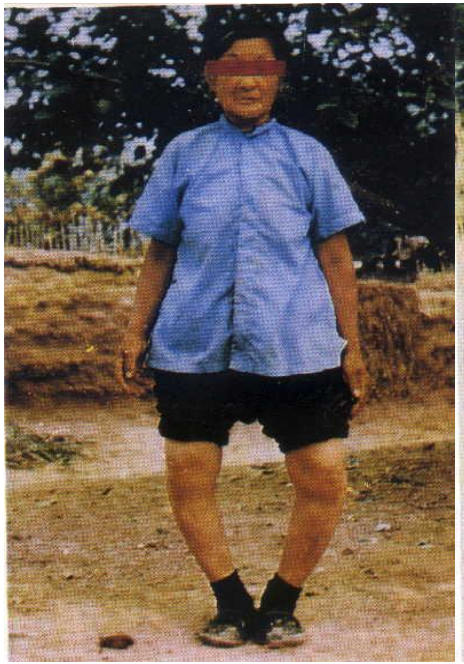
Dental fluorosis

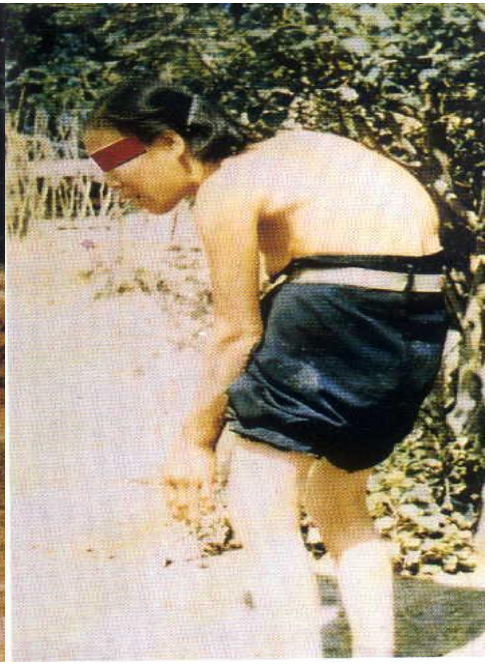
Gray or black discoloration on the external enamel surfaces of the permanent teeth



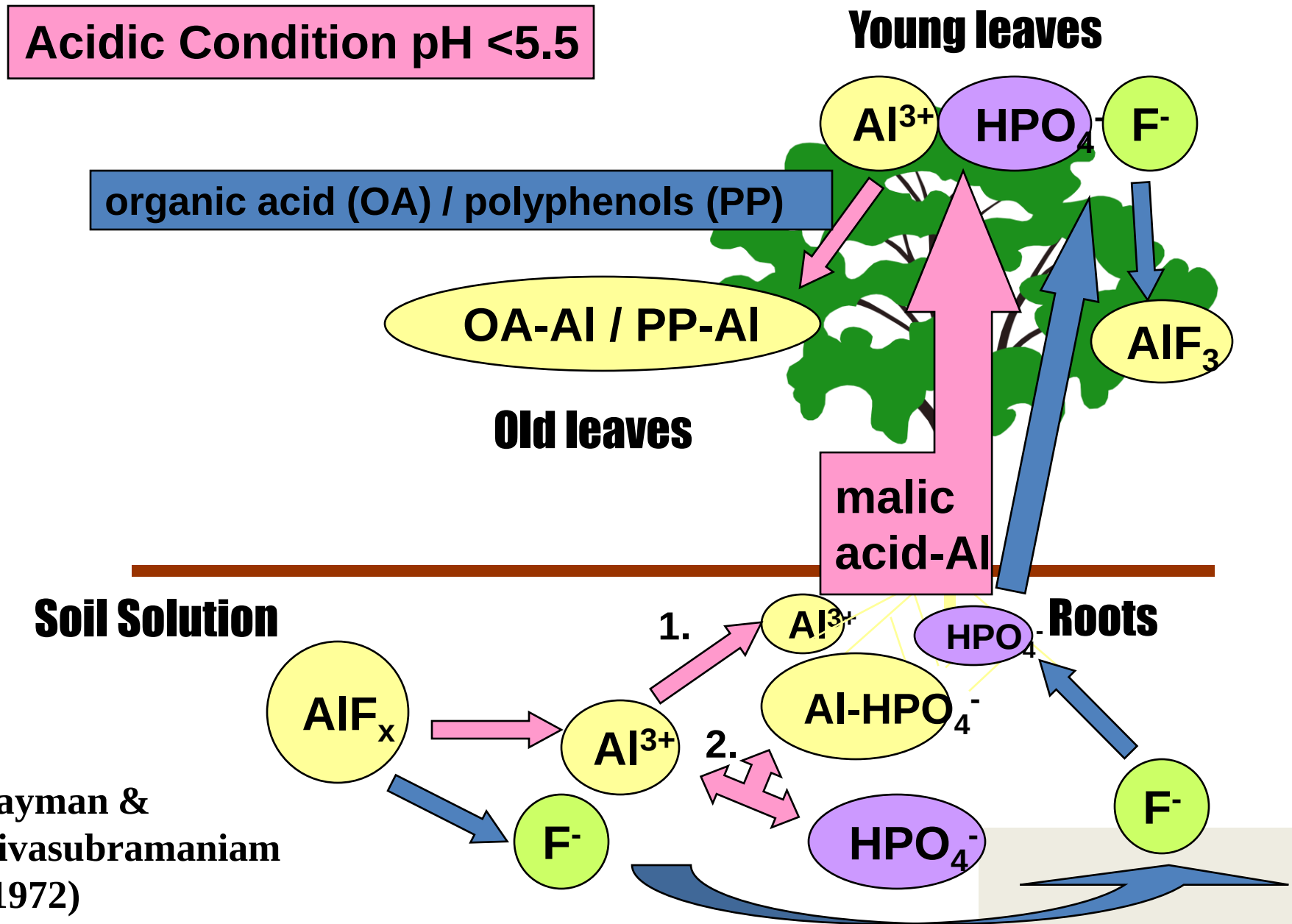
Skeletal fluorosis

LEFT: Bent-legged.
RIGHT: Spine deformation.



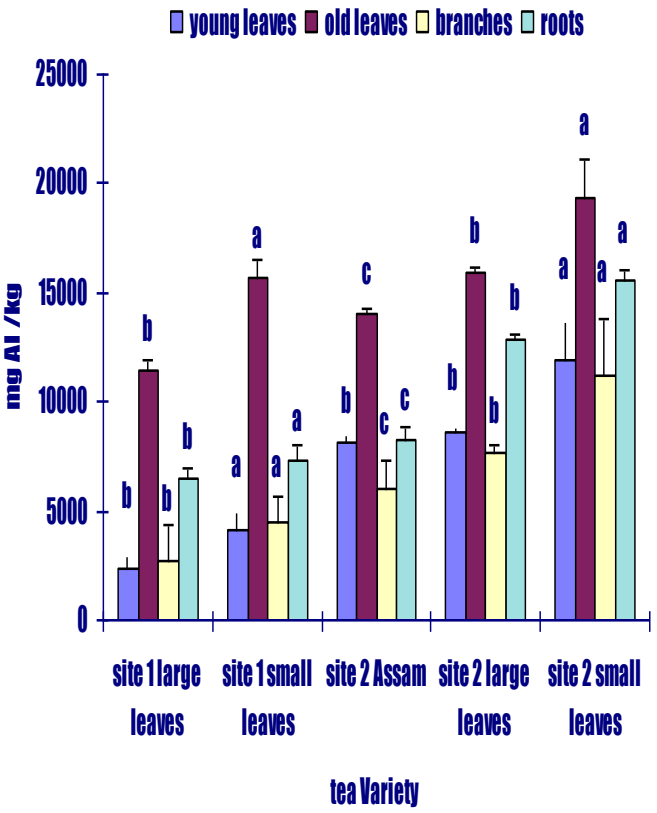


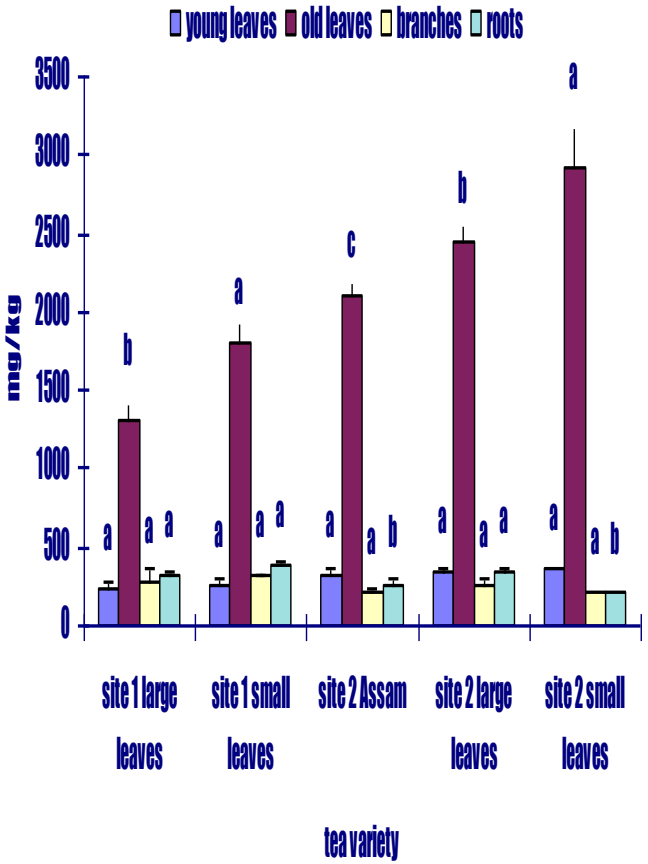
Pathways of Al & F from soil to tea plant

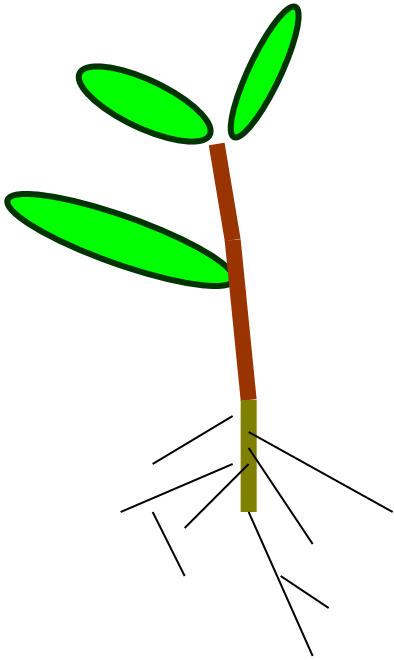


Jayman & Sivasubramaniam (1972)

Al & F concentrations in tea plantation (H.K.)







Same letters within the same part of tea bushes at the same site indicate no significant difference at $p<0.05$, according to Duncan's Multiple Range Test

Case Study 3: Health Risk Assessments of Consumption of HK Market Fish (Hg, DDTs & PBDEs)

10 Freshwater species

Orecochromis mossambicus (Tiliapia)

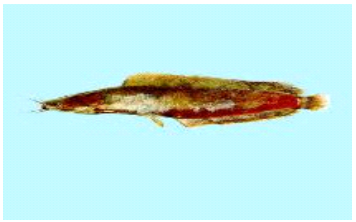
Ctenopharyngodon idellus (Grass carp)

Siniperca chuats (Mandarin fish)

Mugil cephalus (Grey mullet)

Monopterus albus (Rice field eel)

Cirrhinus molitorella (Mud carp)



Clarias fuscus (Catfish)

Channa Maculata (Spotted snakehead)

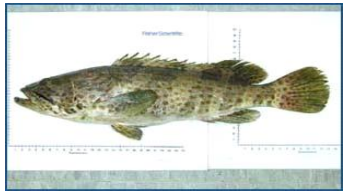
Channa Asiatiea (Small snakehead)

Aristichthys nobilis (Big head)

10 Marine species

Acanthopagrus latus (Yellowfin seabream)

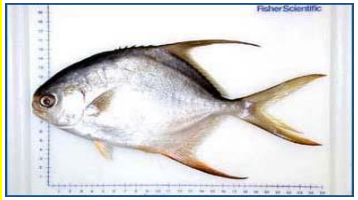
Nemipterus virgatus (Golden threadfin bream)



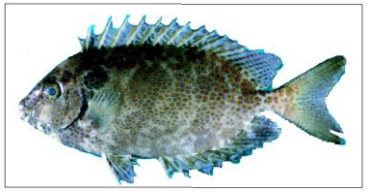
Epinephelus coioides (Orange-spotted grouper)

Epinephelus bleekeri (Bleeker's grouper)

Priacanthus macrac-anthus (Bigeye)



Trachinotus blochii (Snubnose pampano)



Siganus punctatus (Goldspotted rabbitfish)

Platycephalus indicus (Bartail flathead)

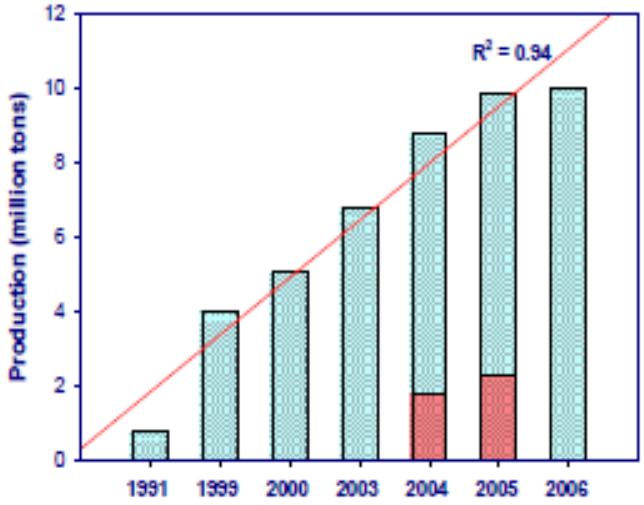
Pseudosciaena crocea (Yellow croaker)

Cynoglossus robustus (Tongue sole)

Fish Feeds- major sources of contamination in fish

(1) Trash fish – mainly wild, various species, with low commercial value

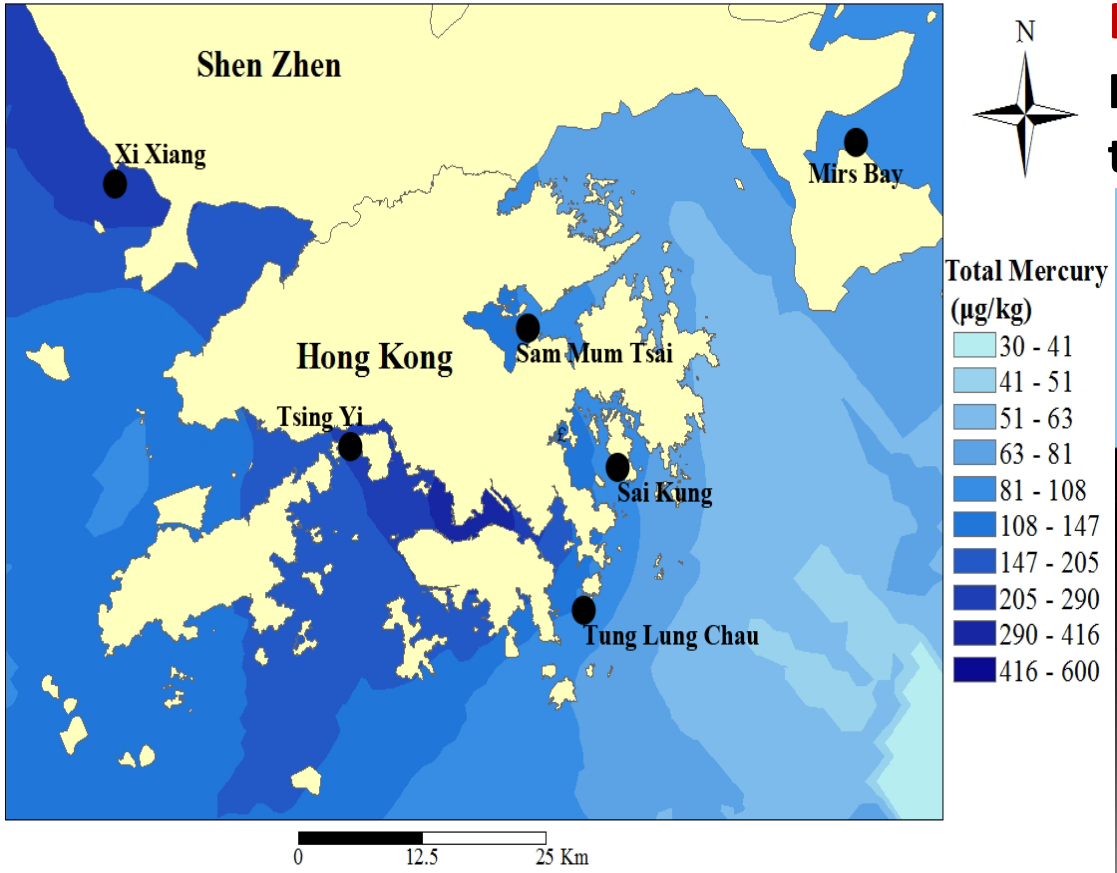
(2) Compound feed (fish meal) – made from various materials including trash fish



State of World Fisheries & Aquaculture, 2006

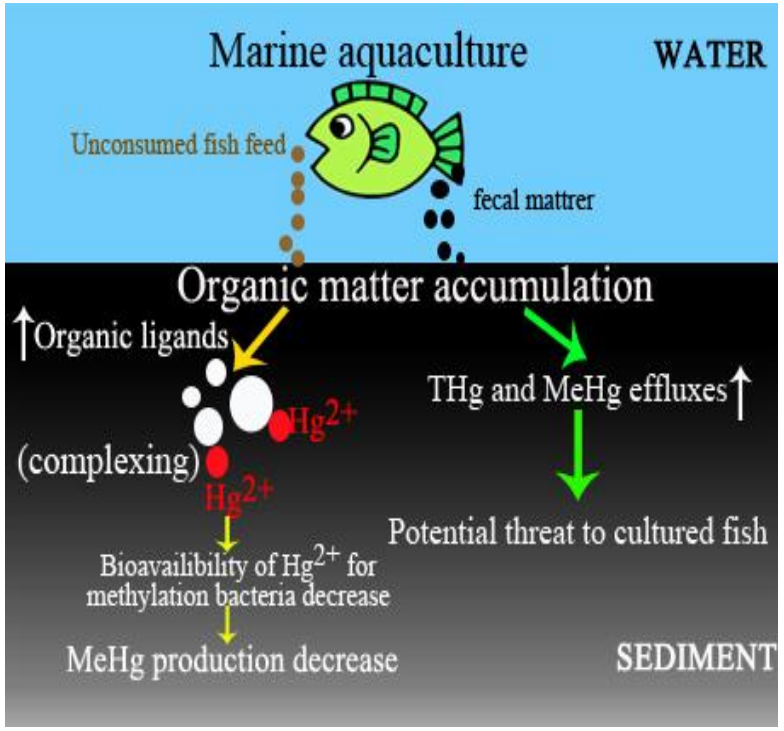
Source of Hg: Coal combustion

Hg distribution in sediments around HK coastlines



Hg speciation in mariculture sediments:

Inorganic – Organic Hg (Methyl Hg through sulfate reducing bacteria)?



Liang P, Wu SC, …, Wong MH (2012) .. *Mar Pollut Bull* 64

Liang P,… Wu SC, ..Yu S, Wong MH (2013) *J Hazard Mater* 15

Liang P, …Wu SC, .. Wong MH (2013). *Sci Total Environ* 463

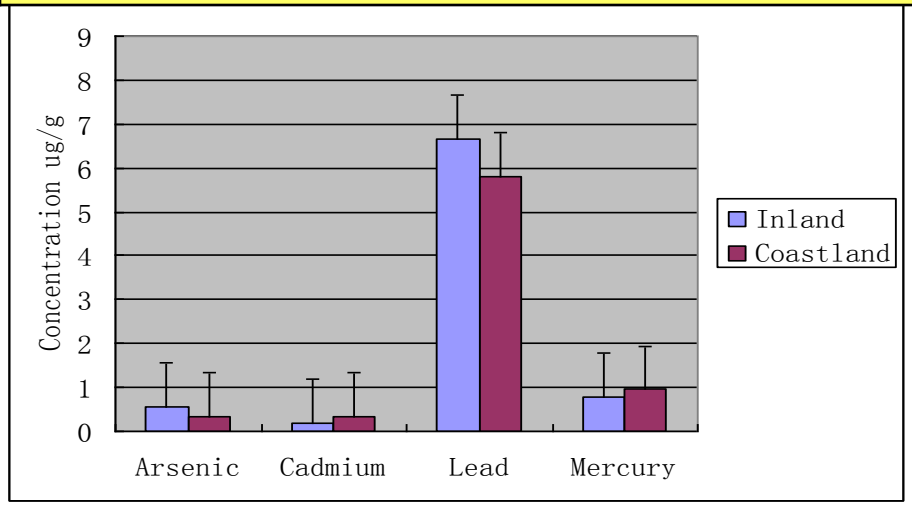
Shao DD,… Wu SC, Wong MH (2012) *Sci Total Environ* 424

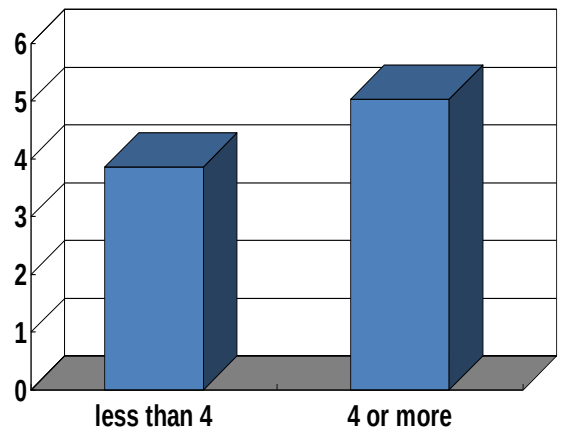
Shao DD, ….Wu SC, … Wong MH (2013) *Food Chem* 136

Sources, Fates & Effects of Mercury

Subfertility of HK Males Linked with High Fish Consumption (Dr C Leung, MD)

Mercury & Lead Related to Autism in Children (Dr L Ko, MD)





- Childhood IQ decrease of 0.18 points per ppm rise in maternal hair Hg
- Will give rise to substantial economic loss

VESTED FINANCIAL INTEREST IN:

1-"Thimerosal" (Ethylmercury) in vaccines (linked with autism, confirmed by USEPA recently)

2- Coal burning power plants

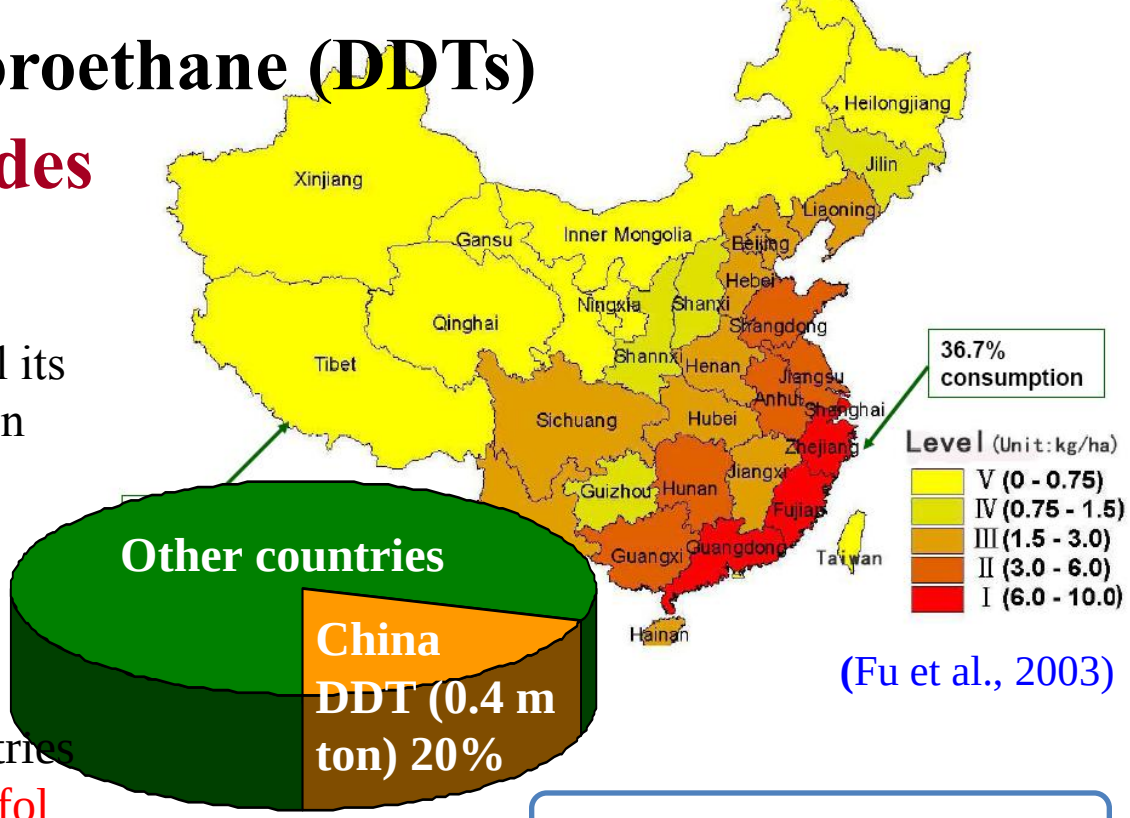
3- Fish Industry

Hg Overload & Eczema (Dr P Lam, MD)

Dichlorodiphenytrichloroethane (DDTs)

Organochlorine pesticides

China has been a major **producer & consumer** of DDTs, until its ban on production & agricultural use in 1983 (Wong et al, 2005)



(Fu et al., 2003)

China has been exempted to

(1) use DDT for vector control,
(2) export DDT to some African countries
(3) use DDT in the production of dicofol (a miticide)

DDT has also been used illegally to produce

(1) anti-fouling paints for ships & fish cages
(2) agricultural production

DDT is **lipid-soluble** & could be accumulated progressively along food chains (Wong et al, 2002).

Adverse health effects

Exposure to **DDT** can increase rate of having breast cancer (Cohn et al, 2007)

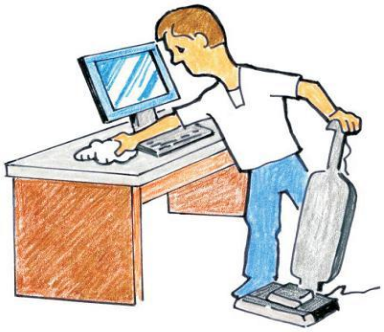
DDT & its metabolites are endocrine disruptors (Lopez-Espinosa et al, 2007).

Pregnant women & fetus are especially vulnerable to DDTs (Falcón et al, 2004)

Polybrominated diphenyl ethers (PBDEs)

PBDEs are **organobromine compounds** used as **flame retardant** .

Human exposure to PBDEs



(1) Oral Route, (2) Indoor dust inhalation

Adverse health effects

Animal studies -PBDEs can cause health problems such as **thyroid hormone disruption**, & possibly **cancer** (ATSDR, 2002).

PBDEs are accumulated & caused problems in ***brains*** of developing mice (Viberg et al, 2011)

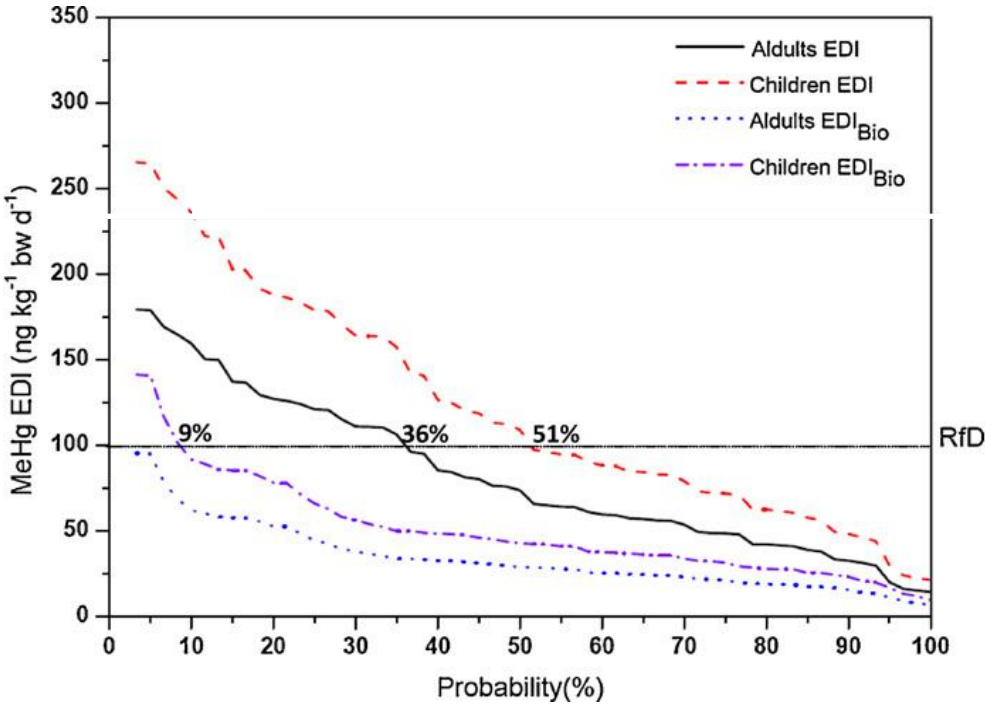
The greatest source for human exposure to PBDEs is **daily oral intake** (Johnson-Restrepoa et al. 2009) and **indoor dust inhalation** (Kang et al. 2012).

Exposure of HK residents to Hg & MeHg via Consumption of Market Fish (*In vitro* Estimation)

- **Wang HS...Man YB...Wong MH (2013).** ***J Hazard Mater***

The highest total Hg were observed in **Snubnose pompano** (210 ± 117 ww)

In general, **marine fish** (64.4 ± 28.5 ng g^{-1}) contained significantly higher MeHg than those in **freshwater fish** (40.3 ± 26.0 ng g^{-1}).



Marine fish - involved in more complicated food webs & longer food chains in natural environment, while freshwater fish - grown under controlled conditions, with truncated & artificial trophic levels (Schusteret al, 2011)

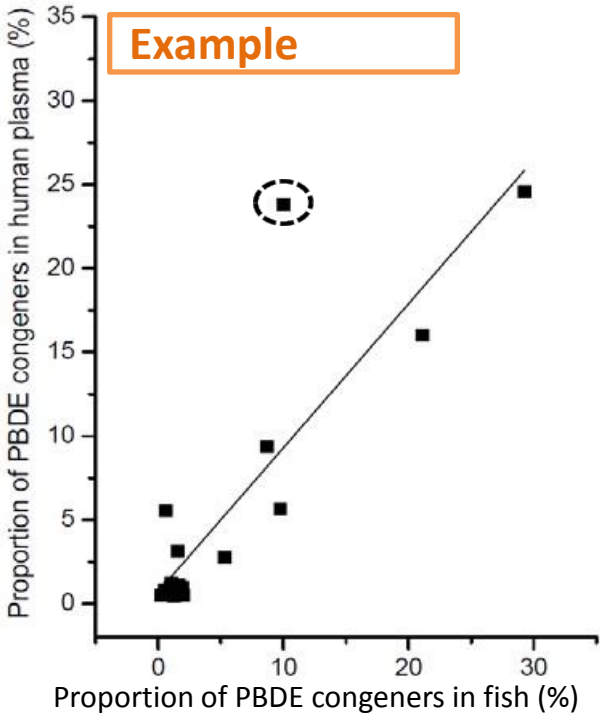
Consumption of local fish on **health & development of children** in HK – public concern

Hg, DDT, ∑PBDEs, ∑MeO-BDEs, ∑OH-BDEs, & ∑BRPs in Blood Plasma of HK Residents

- Wang HS… Man YB… Wong MH (2013). *Environ Int*
- Wang HS…Man YB… Wong MH (2013). *J Hazard Mater*
- Wang HS…Wong MH (2012). *Environ Int*
- Liang P…Wong MH (2013). *J Hazard Mater*

116 participants (female 54, male 62)

Contaminants	Concentrations in blood plasma (pg g $^{-1}$ lipid) Median (range); # Mean (range) (ug/L)
THg	0.63# (0.13 to 2.08)
MeHg	0.28# (0.05 to 1.56)
DDTs	9×10^5 (1.7×10^5 to 8.8×10^6)
$PBDE_{22}$	5.4×10^3 (0.56×10^2 to 92×10^3)
MeO-BDEs	4.5×10^3 (3.8×10^2 to 52×10^3)
OH-BDEs	81 (5.3 to 4.9×10^2)
BRPs	3.7 (Not detected to 1.1×10^2)

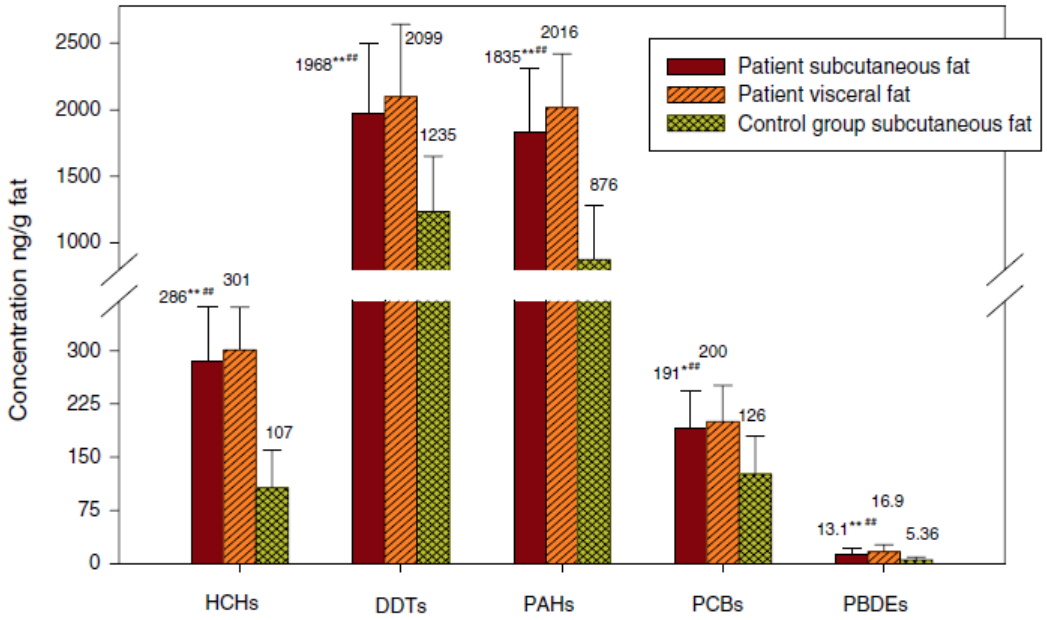


There were significant positive correlations between levels of THg, MeHg, DDTs and PBDEs in blood plasma of HK residents and in market fish.

PAHs, OCPs (DDTs, HCH), PCBs, PBDEs & Hg in Adipose Tissues of Patients with Uterine Leiomyomas - Seafood Diet

With Dr CKM Leung**, Director of *In Vitro* Fertilization Clinic**

Qin YY, Leung CKM …Wong MH (2010) *Environ Sci Pollut Res* 17: 229-40



* p <0.05, ** p <0.01 between subcutaneous fat of patients and control group (Student *t* test)

# p <0.05,## p <0.01 patient's subcutaneous and visceral fat correlation (Pearson's correlation), the correlations: PCBs (r=0.979), DDTs (r=0.924), HCHs (r=0.745), PAHs (r=0.797) and PBDEs (r=0.888)

Total HCHs refer to the sum of β-HCH+ γ-HCH

Total DDTs refer to the sum of pp-DDE, pp-DDD and pp-DDT.

Total PAHs, PCBs and PBDEs represent the sum of all the compounds.

	Heavy metal	Hg (μg/g/kg fat)
Patient group (n=20)	**Subcutaneous fat**	**9.12 ± 3.87** ** and ##
	Visceral fat	13.3 ± 2.47
Control group (n=20)	**Subcutaneous fat**	5.94 ± 1.75

** and ## = **P<0.01 between**

(1) Subcutaneous fat of patients & control group

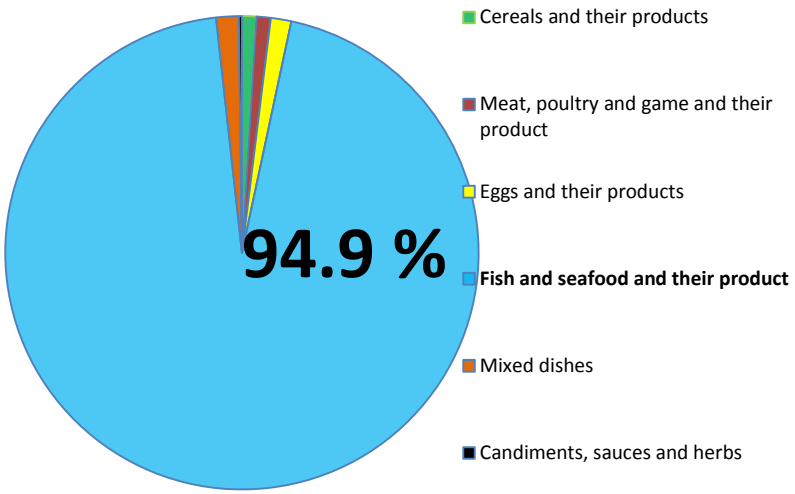
(2) Patient's Subcutaneous & visceral fats, respectively.

Patients accumulated significantly *higher* (p<0.01 or 0.05) DDTs, HCHs, PCBs, PAHs, PBDEs & Hg in adipose tissues, compared with healthy females

The 1st HK Total Diet Study Report on MeHg

食物安全中心
Centre for Food Safety

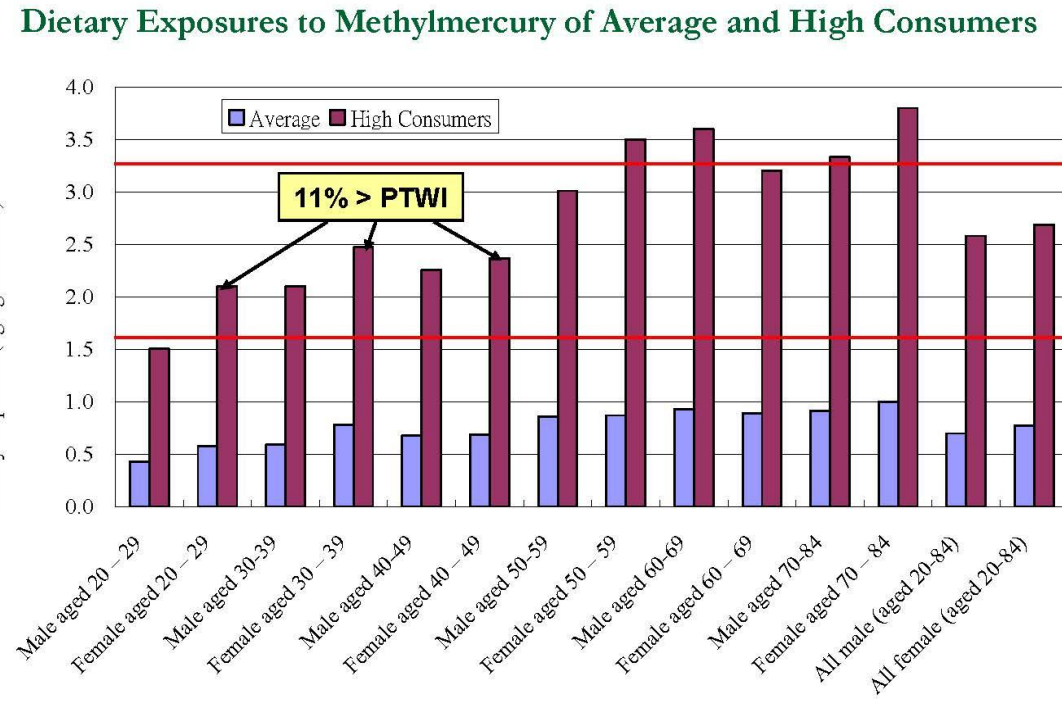
Food groups MeHg conc. (%)



- Centre for Food Safety, HK (2013).

204 composite samples, 51 food items, 6 food groups

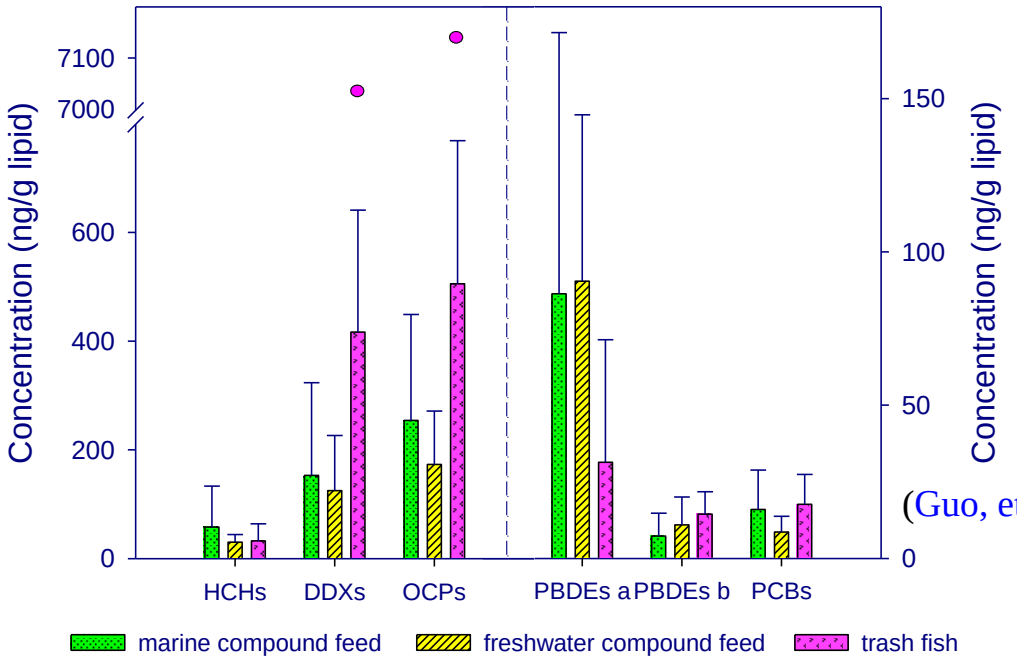
Dietary exposure to MeHg: **Health concern to 11% of women aged 20-49 (childbearing age)**



About 11% of women aged 20-49 (childbearing age) had dietary exposure to methylmercury exceeded the PTWI of 1.6 μg/kg bw/week.

Use of food wastes to replace fish meal for fish culture: Health risk assessments of cultured fish

(1) Replacing fish meal by food waste… acceptable levels of OCPs.. *Environ Int* 73
(2) Hg levels on culturing low trophic level fish using food waste *ESPR* (in press).
Cheng Z., Mo WY, ….. Wong MH (2014).



(Guo, et al., 2009)

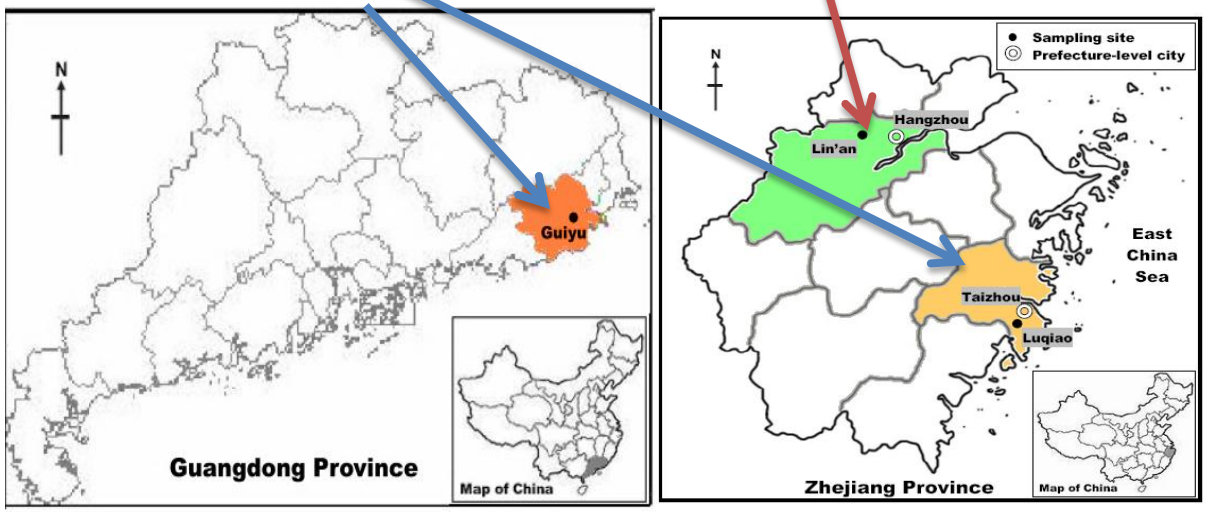
	Mean ± S.D, μg/kg. dry weight	
	Total mercury	**Methyl mercury**
Trash fish	**264.3 ± 7.14*** **	**108 ± 5.37*** **
Pellet feed	22.4 ± 3.29	8.50 ± 1.32

Significantly higher THg ($p < 0.001$) and MeHg ($p < 0.001$) concentrations in trash fish were detected than those in feed pellets (Liang et al., 2012)

Case Study 4: Dietary Intake & Body Loadings (Hair, Milk, Placenta) of PBDEs & DDTs of Residents at 2 E-Waste Recycling Sites

2 coastal cities

A control site: an inland city



E-waste has evolved into a complex social & global problem

Uncontrolled E-Waste Recycling

- Dismantling of E-wastes
- Use of strong acids to extract gold, silver & platinum
- Baking of printed circuit boards on open fire indoor
- Open burning of E-wastes outdoor

Wong MH et al (2007) Environ Pollut

Open Burning of E-Waste – Air pollution

PCDD/Fs
PBDD/Fs
PBDEs
PAHs
PCBs
Heavy Metals

- Cu acts as catalyst for the formation of PCDD/Fs during combustion of PVC
- Burning of insulated wires generates 100x more PCDD/Fs than domestic waste

(Gullet et al., 2007)

(Photos by CIES, 2004)

Food Consumption Survey

Semi-quantitative food intake questionnaires & face-to-face interviews

A. 饮食习惯 (Food Consumption Survey)

请选择下列左侧图中所示食物的饮食**总**次数和**总**数量，**每份份量如图中所示**：

范例


菜芯


青菜


芥兰


油麦菜


芹菜

请选择左侧图中所示食物的饮食**总**次数和**总**数量，**每份份量如图中所示**：

怀孕前

每周吃 **2 次**菜芯、**1 次**青菜，**1 次**芥兰，**1 次**芹菜，每样每次各吃 **1 份**，所以总计**每周**吃 **5 份**。

☐ 每日 ☑ 每周 ☐ 每月

☐ 0 份 ☐ 1 份 ☐ 2 份 ☐ 3 份

☐ 4 份 ☑ 5 份 ☐ 6 份 ☐ 6 份以上

怀孕期

每日吃 **1 次**菜芯，每一次吃 **2 份**；**1 次**油麦菜，每次 **1 份**，所以总计**每日**吃 **3 份**。

☑ 每日 ☐ 每周 ☐ 每月

☐ 0 份 ☐ 1 份 ☐ 2 份 ☑ 3 份

☐ 4 份 ☐ 5 份 ☐ 6 份 ☐ 6 份以上

鱼类


鲫鱼


鲤鱼


草鱼


大头鱼


带鱼


鲫鱼


黄花鱼/黄鱼

怀孕前

☐ 每日 ☐ 每周 ☐ 每月

☐ 0 份 ☐ 1 份 ☐ 2 份 ☐ 3 份

☐ 4 份 ☐ 5 份 ☐ 6 份 ☐ 6 份以上

怀孕期

☐ 每日 ☐ 每周 ☐ 每月

☐ 0 份 ☐ 1 份 ☐ 2 份 ☐ 3 份

☐ 4 份 ☐ 5 份 ☐ 6 份 ☐ 6 份以上

怀孕前

☐ 每日 ☐ 每周 ☐ 每月

☐ 0 份 ☐ 1 份 ☐ 2 份 ☐ 3 份

☐ 4 份 ☐ 5 份 ☐ 6 份 ☐ 6 份以上

怀孕期

☐ 每日 ☐ 每周 ☐ 每月

☐ 0 份 ☐ 1 份 ☐ 2 份 ☐ 3 份

☐ 4 份 ☐ 5 份 ☐ 6 份 ☐ 6 份以上

B. 个人信息调查表 (Socio-Demographics Questionnaire)

采样负责人姓名：_____ 采样人职业：_____

采样日期 乳汁：____年____月____日 样品编号：_____

头发：____年____月____日 样品编号：_____

胎盘：____年____月____日 样品编号：_____

（一） 基本信息

1. 姓名：_____
2. 出生日期：____年____月____日 身高：____厘米 体重：____斤
3. 自我感觉目前身体状况如何：
   ☐ 很好 ☐ 较好 ☐ 一般 ☐ 差 ☐ 很差
4. 在台州居住：____年
5. 以前是否曾在台州以外地区长久居住（超过半年以上）？
   ☐ 是（请详细回答） ☐ 否（请答第 6 题）
   居住时间：____ 年____月 至 ____ 年____月，居住省份：_____
6. 常患疾病
   ☐ 头痛、头晕
   ☐ 耳鸣
   ☐ 肾结石
   ☐ 慢性支气管炎、哮喘、鼻炎、咽喉炎等呼吸道疾病
   ☐ 过敏性皮炎、接触性皮炎
   ☐ 浅表性胃炎、胃溃疡
   ☐ 十二指肠溃疡、肠梗阻、胰腺炎
   ☐ 其他，请注明：_____
7. 家族病史：
   ☐ 高血压 ☐ 冠心病 ☐ 糖尿病 ☐ 肿瘤 ☐ 其他，请注明：____

（二） 怀孕记录

怀孕次数：____次 生育次数：____次 流产次数：____次

怀孕前正常体重：____斤 怀孕期间体重：____斤

此次怀孕周数：____周 以前母乳育婴：____次（婴）

以前用母乳育婴共：____月 此次母乳育婴：____周

（三） 工作

从事工作是否与电子垃圾回收处理或大型机电设备回收处理有关？

☐ 有关（请往下作答） ☐ 无关（请答第（四）部分）

具体工种_____ 从事时间_____

工作条件：☐ 吸入异味气体

☐ 皮肤暴露接触 ☐ 皮肤间接接触

☐ 长期接触 ☐ 偶尔接触

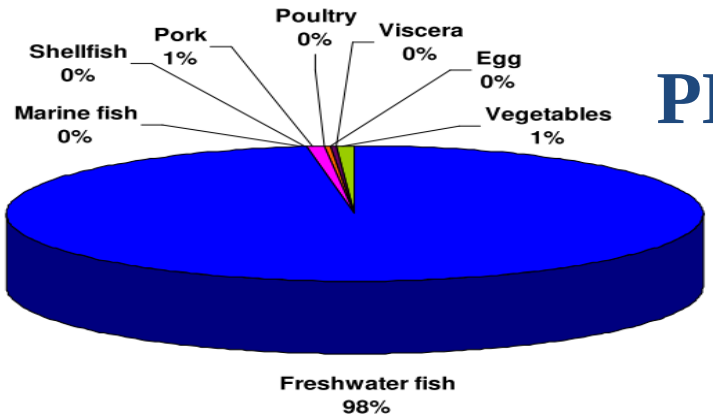
Contributions from 9 Food Groups to the Dietary Intakes of PBDEs & DDTs

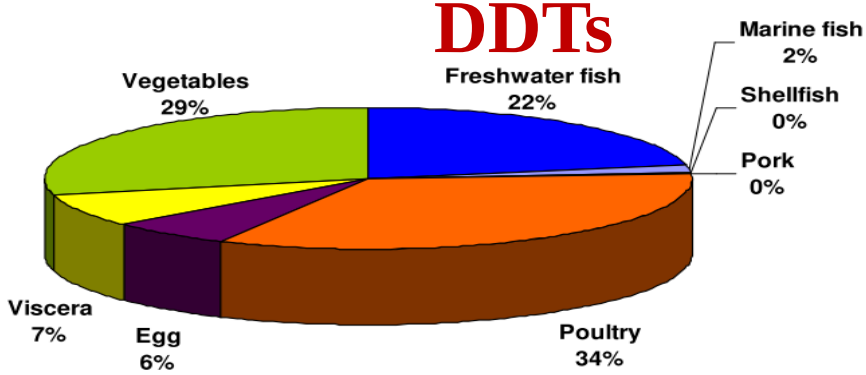
- Chan JKY, Man YB…Wong MH (2012). *Sci Total Environ*
- Man YB,.. Wong MH (2013). *Sci Total Environ*

PBDEs

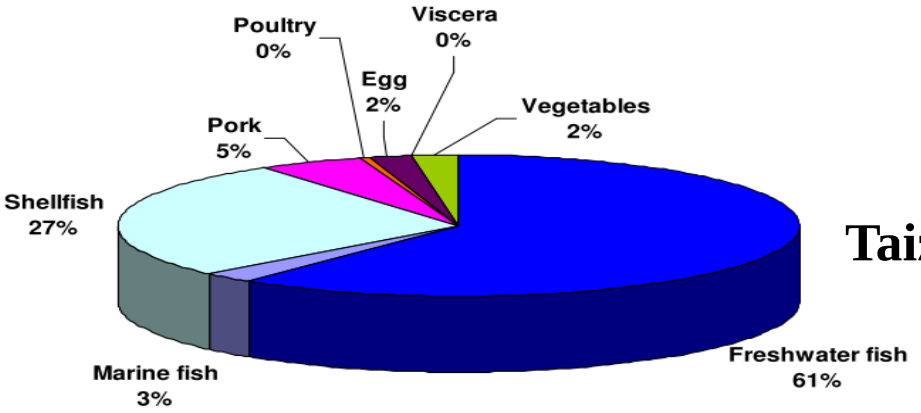
DDTs

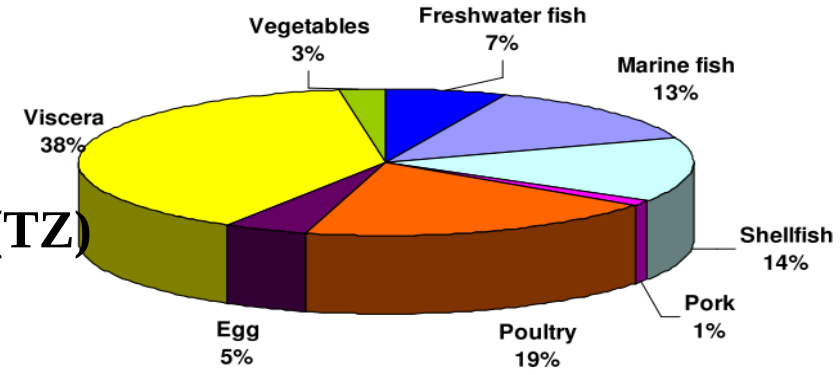
Guiyu (GY)



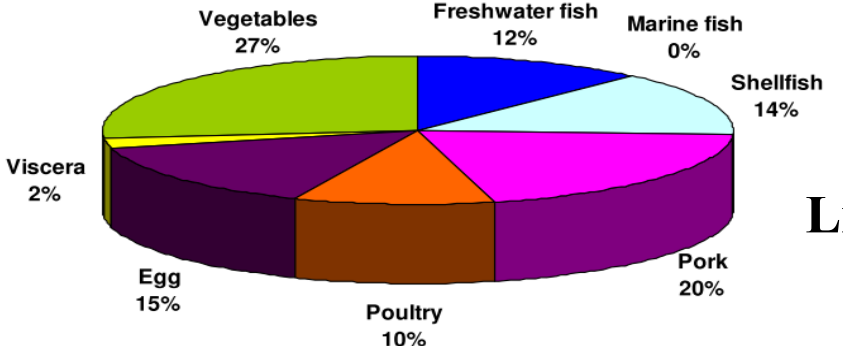


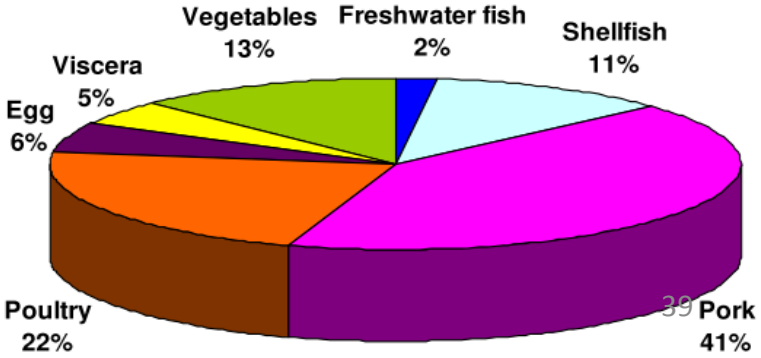
Taizhou (TZ)





Lin'an (HZ)





Estimated Daily Intakes of PBDEs & DDTs – Adults & Infants

- Leung AOW…MH Wong (2012). *Environ Sci Pollut Res*
- Man YB, …. MH Wong (2013). *Environ Int*

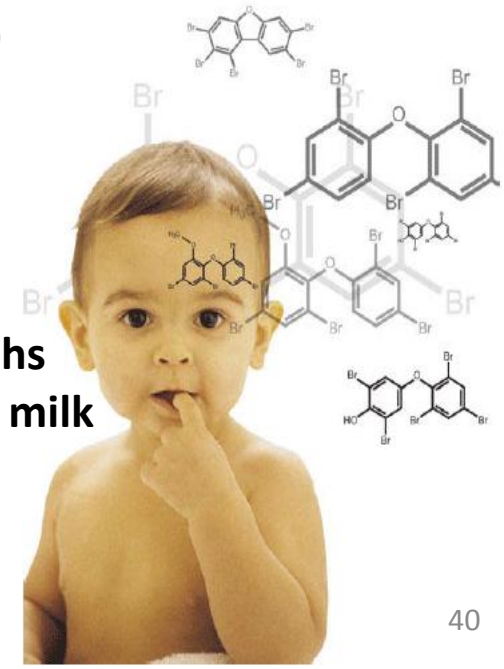
Estimated Daily Intake	Population group	Guiyu	Taizhou	Lin'an
ΣPBDEs (ng/kg bw/day)	Adults	931 ± 772	44.7 ± 26.3	1.94 ± 0.86
	Breast-fed infants	**461 ± 423***	**346 ± 559***	**7.01 ± 3.95***
DDTs (ng/kg bw/day)	Adults	31.5 ± 34.8	52.1 ± 49.5	13.0 ± 6.51
(μg/kg bw/day)	**Breast-fed infants**	**1.48 ± 0.79***	**1.69 ± 1.86***	**0.95 ± 0.73***

*= significant different at ($p<0.05$)

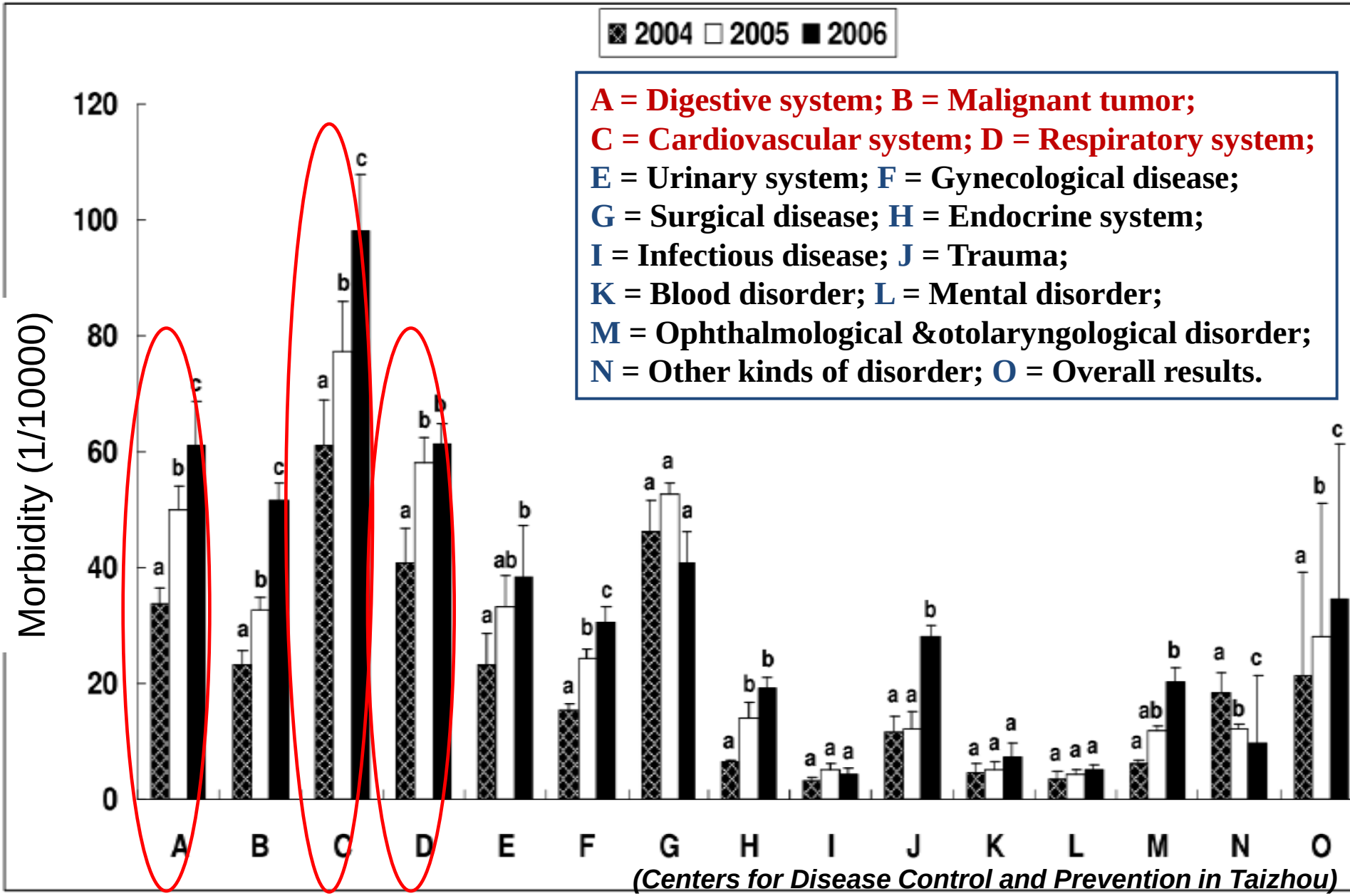
Non-cancer risk

Hazard Quotient of consumption of human milk for infants

	Guiyu	Taizhou	Lin'an
BDE 47	**66.2**	**38.6**	0.434
BDE 99	**7.9**	**15.1**	0.0683
DDTs	0.148	0.169	0.095



Epidemiological Data from Taizhou (2004-2006)



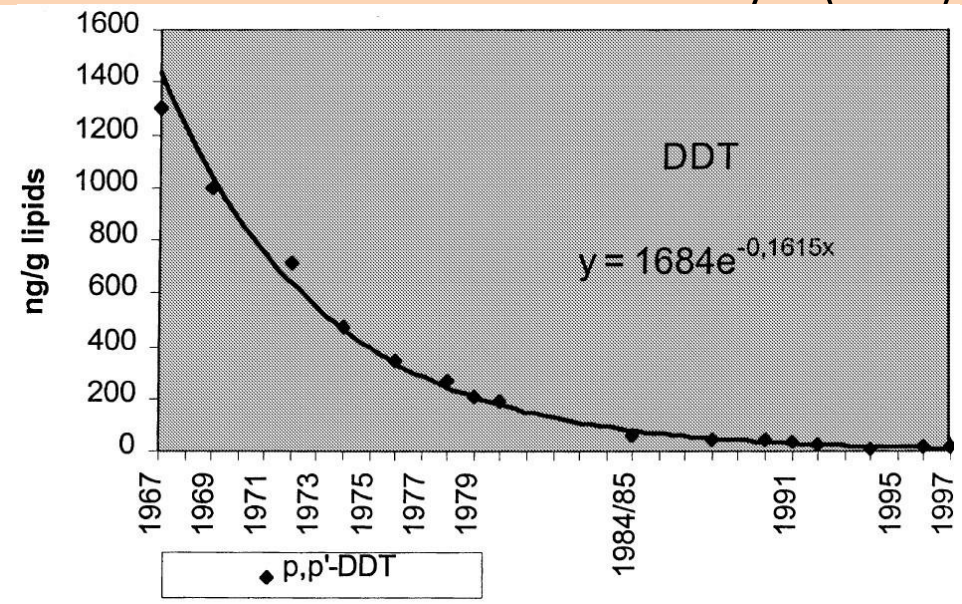
(Centers for Disease Control and Prevention in Taizhou)

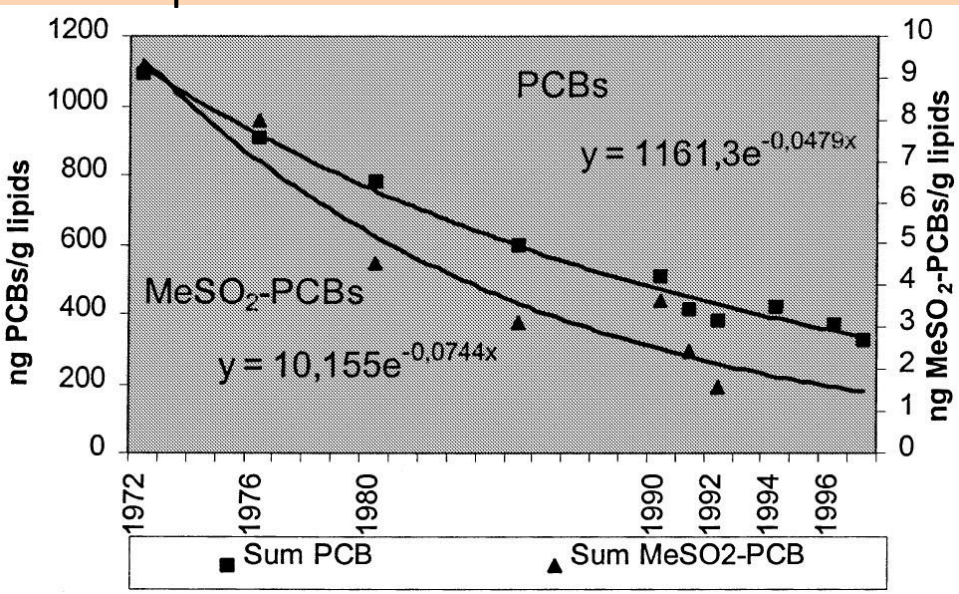
MANAGEMENT ISSUES OF PTS

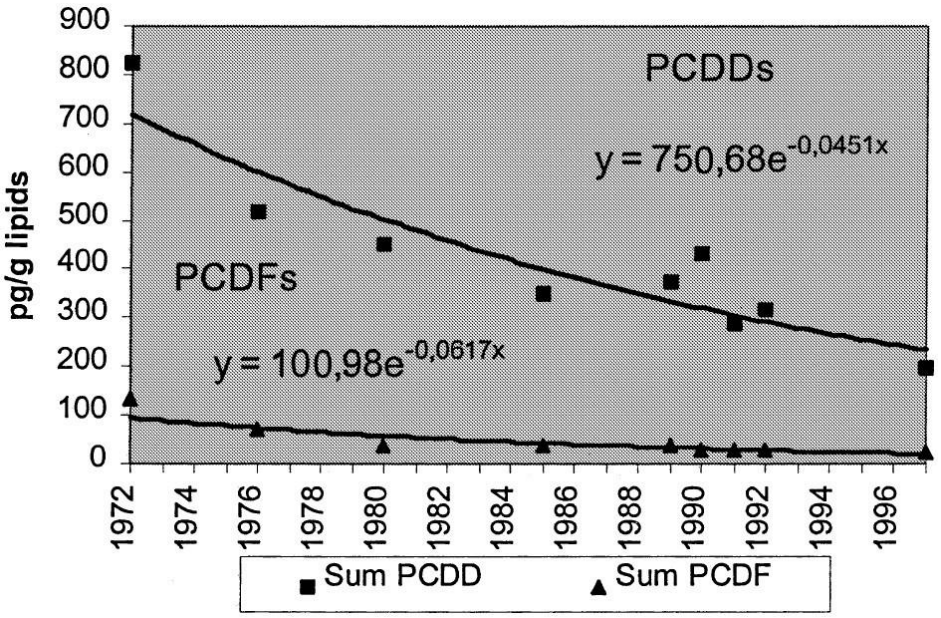
- A world-wide concern
- **GEF Guidance on Emerging Chemicals Management Issues** Bouwman H, Wong MH, Barra R (2012) *UNEP/GEF*
- **PTS: Sources, fates & effects**
  Wong MH, Armour MA, Naidu R, Man M (2012) *Rev Environ Health* 27
- **Bisphenol A (BPA) in China: A review**
  Huang YQ, ….Barra R, Wahlstrom B, …, Wong MH (2012) *Environ Int* 42
- **PPCPs: A review on environmental contamination in China**
  Liu JL, Wong MH (2013) *Environ Int* 59

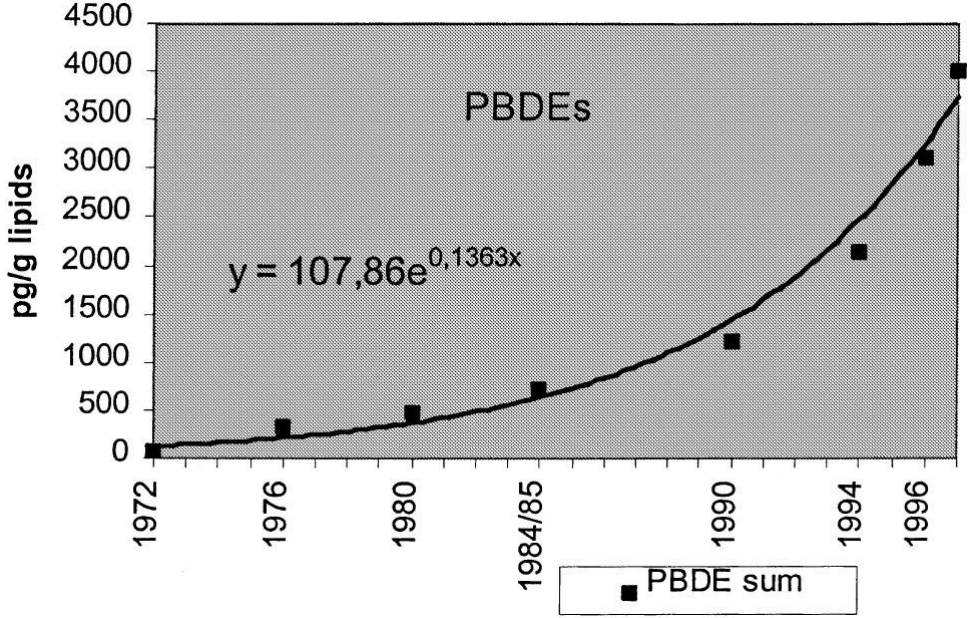
DDT, PCBs, PCDDs & PBDEs in Human Milk – Stockholm Region (expressed as an exponential curve)

Noren & Meironyte (2000) Chemosphere 40: 1111-23









New Chemicals (some statistics)

- **As of 4/18/2007**
  - **> 30 million (31,322,549)** organic & inorganic substances (excluding proteins & nucleotides) have been registered
  - **About 14 million (13,780,301)** are commercially available
  - **< 0.5 million (245,316)** are inventoried or regulated substances
- **Two years later**
  - **> 5 million** new chemicals have been registered
  - **About 5 million** additional chemicals are commercially available
  - **Only 5,316** additional substances have been added to inventoried/regulated lists

（Equivalent to 0.1% of new or commercially available chemicals）

Source: http://www.cas.org/cgi-bin/cas/regreport.pl
Chemical Abstracts Service (CAS) Registry

A World-Wide Concern –

A Project Supported by UNEP/GEF

Hindrik Bouwman, Ming Hung Wong, Ricardo Barra

http://stapgef.org/pops-and-ozone

Emerging Chemicals Management Issues in Developing Countries and Countries with Economies in Transition

- To support the Global Environment Facility (GEF) **immediate goal in its chemicals program**

  - "to promote the **sound management of chemicals** throughout their life-cycle in ways that lead to the **minimization of significant adverse effects on human health and the global environment**".

- The drafting group, with the assistance of STAP (GEF), **identified a preliminary list of Emerging Chemicals Management Issues (ECMIs)**

  - based on **numerous policy & guidance documents, combined knowledge, & active screening of recent literature**.

Emerging Chemicals Management Issues Identified

(with no order of precedence)

Compound/ Class Based:

1) PAHs
2) Arsenic
3) Bisphenol A
4) Alkylphenols
5) Parabens
6) Phthalates
7) PBDEs
8) TBTs
9) PFOA/PFOS
10) Heavy Metals

Product Based:

1) Pb in Paints
2) Artificial Fertilizers
3) Cd Fertilizers
4) Pharmaceuticals & Personal Care Products
6) Illicit Drugs
7) Food Additives – Melamine in milk

Effect Based:

1) Endocrine Disruption

Process Based:

1) E-waste
2) Ammunition, Propellants, Military Equip, & Environ Chem Legacy of War & Conflict
3) Mine Wastes/Drainage
4) Sewage Sludge/Biosolids - for Land Application
5) Open Burning – with emphasis on open burning of biomass

Strategic Approach to International Chemicals Management

-A policy framework to foster the sound management of chemicals

-Initial examination of priority setting by National Stakeholders
-Development of a STAP advisory document to GEF, in cooperation with SETAC

SAICM Side Event:

Introduction to Emerging Chemicals Management Issues in Developing Countries and Countries with Economies in Transition:

Initial examination of priority setting by National Stakeholders

Development of a STAP advisory document to the GEF, in cooperation with SETAC

The immediate goal of the Global Environment Facility (GEF) through its present chemicals program is **to promote the sound management of chemicals throughout their life-cycle in ways that lead to the minimization of significant adverse effects on human health and the global environment.**

The GEF's Scientific Technical Advisory Panel (STAP) recognizes the last two decades' rapid increase in new chemicals, uses, or products, fueling or fueled by a concomitant increase in demand, increased trade, and expansion of manufacturing of chemicals into Developing Countries and Countries with Economies in Transition (CEIT). This period has also seen a rapid implementation of multilateral environmental agreements (MEAs) to meet the expanded chemicals management demands.

In this context, the Strategic Approach to International Chemicals Management (SAICM) acts as the focus for a globally effective and sustainable chemicals management process to help respond to the ever-increasing range of chemicals in global use.

Speakers include

Hindrick Bouwman, *STAP Chemicals Panel Member*
Ricardo Barra, *Consultant to STAP*
Ming H Wong, *Consultant to STAP*
Michael Mozur, *Global Executive Director, SETAC*

The STAP Chemicals Panel member, along with the Society of Environmental Toxicology and Chemistry (SETAC) and colleagues of the scientific community have focused on Emerging Chemical Management Issues (ECMIs), defining them for purposes of advising the GEF on any potential or recognized human health and/or environmental effects associated with chemical(s) whose management is not, or only partially addressed by, existing MEAs.

Based on the results of a chemicals prioritization survey of developing country and CEIT respondents, SETAC members and other experts, the STAP is developing an advisory paper for the GEF Council to identify, evaluate and prioritize ECMIs in relation to the likely chemical management needs of these countries, such that additional resources and support from the GEF will anticipate, prevent, reduce and/or minimize adverse impacts on human health and the environment within the chemicals focal area.

In this event, the GEF STAP Chemicals expert, SETAC Global Executive Director, and other internationally renowned scientists will lead a discussion on the results of their work to date.

Where: *Hall 1 (Annex B)*

When: *Friday, November 18, 14.00h to 15.00h*

Catering will be provided

Scientific and Technical Advisory Panel

An independent panel of scientists that advises the Global Environment Facility

UNEP

GEF Guidance on Emerging Chemicals Management Issues in Developing Countries and Countries with Economies in Transition

Scientific and Technical Advisory Panel

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Table 1: Regional and all-regional ECMIs ranked on Aggregate concern

ECMI	Central & South America	Africa	Asia	Eastern Europe	Oceania	**All regions - Oceania**	**All regions + Oceania**
Heavy metals	1	1	1	1	3	**1**	**1**
PAHs	3	2	2	4	2	**2**	**2**
Mixture effects	2	7	6	2	15	**3**	**4**
Open burning	5	5	3	3	1	**4**	**3**
Endocrine disruption	4	12	4	7	12	**5**	**6**
Sewage	6	10	12	6	5	**6**	**5**
Inorganic fertilizer	8	9	13	5	7	**7**	**7**
Arsenic	10	11	5	10	9	**8**	**9**
E-waste	13	3	7	14	7	**9**	**8**
PPCPs*	7	8	15	11	14	**10**	**11**
Mine waste	11	14	11	8	10	**11**	**10**
Lead in paints	17	4	8	15	16	**12**	**13**
Illicit drugs	9	6	18	19	17	**13**	**14**
Cadmium in fertilizer	12	15	10	16	10	**14**	**12**
Food additives	15	13	14	13	21	**15**	**16**
Phthalates	16	17	16	9	20	**16**	**17**
Bisphenol A	19	20	9	20	18	**17**	**19**
Organotins	18	21	17	12	12	**18**	**18**
Marine debris	14	19	19	21	4	**19**	**15**
Alkylphenols	20	18	20	21	18	**20**	**21**
Ammunition/conflict	22	16	22	18	6	**21**	**20**
Nanoparticle/material	21	22	21	17	22	**22**	**22**

**Pharmaceuticals and personal care products*

A Study of Toxic Substances Pollution in HK

CH2M Hill (China) Ltd (2003)

- Key Task 1: Identify Toxic Substances of Potential Concern to HK (556 chemicals)
- Key Task 2: Evaluate the Toxic Substances Pollution Stage of HK (chemical analyses)
- Key Task 3: Perform Ecological & Incremental Human Health Risk Assessments

- **Final List of Chemicals of Potential Concern (COPC)**

-**Human Health Risk**: Arsenic, DDD, DDE (based on cancer risk)

-**Ecological Risk:**

a) *Water Column Organisms*: Zinc

b): *Benthic Organisms*: Tributyltin, Barium, Beryllium, Copper, Mercury, Silver, Thallium, Tin, Zinc, Fluoride, Hexachlorocyclohexane, Phenol

c): *Marine Mammals*: Selenium, Methyl Mercury

General Conclusion

1. Long-term low dosage of toxic chemicals seemed to be a public concern
2. More stringent control/management of toxic chemicals are essential (emissions & usages)
3. Focus on toxic chemicals common to our region (S China: such as DDT, As, Cd), & emerging chemicals of concern (such as PBDEs, PFOS/PFOA)
4. Cleanup contaminated soils (crop production)
5. Cleanup contaminated sediments (fish production)
6. Ensure toxic chemicals are not used during food production
7. Reactive local agriculture & aquaculture (for safe/quality food, & also cut down foot print & carbon emission)

The End

Thank You