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アフリカ諸国の環境汚染

Environmental Pollution in Africa

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Environmental issues common to Asian countries

For examples

- **Air pollution**
  - In urban areas, air pollutions is becoming pronounced problem because of the use of ill serviced vehicles and lead- gasoline. Dioxins and PAHs also cause air pollution.
- **Water pollution**
  - As water sewage systems in Asia are not maintained well, large amount of domestic / agricultural wastewater is discharged to rivers and lakes.



Environmental pollutants common to Asian countries

For examples

- PAHs (Polycyclic aromatic hydrocarbons, mutagens and carcinogens)
- POPs (persistent organic pollutant)
- Pesticides
  - DDT
  - Organophosphate
  - New generation pesticides, etc.
- PPCPs (Pharmaceutical and Personal Care Products)
- Mycotoxin
- E-waste (metals, etc)
- Metals and Semi-metals



Semi-metal Hazard in Asia

- Regarding pollution by natural sources, even in the present day, the number of people exposed to arsenic (As) by untreated drinking water is estimated over 100 million in rural areas of many Asian countries such as Bangladesh, India, China, Myanmar, Pakistan, Vietnam, Nepal and Cambodia (Fendorf et al. 2010).

What chemical is problem in Africa?

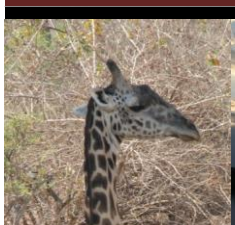
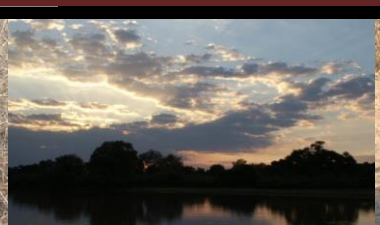
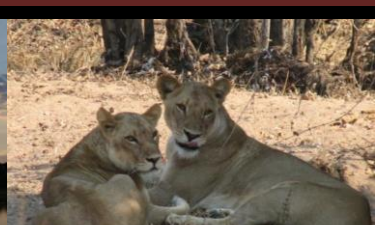
- In 2015, we held 24th Symposium on Environmental Chemistry in Sapporo to discuss on environmental pollution.
- There were reports from Asian countries, India, Vietnam, Philippine, Bangladesh, Indonesia, Thailand, Korea, China, Taiwan, etc... These countries have collaborative research with Japan.
- How is Africa… ? The situation is “Black BOX”…

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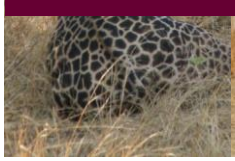
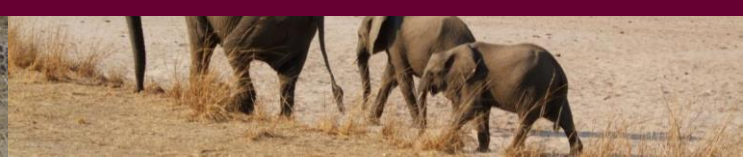


Images (impression) of Africa

(by veterinary students)

- When we ask to Japanese students in our school about their image / impression of Africa…100% of students answer same image as ”Nature and Wildlife”.

Hipo-pool without Hipo



Smog in city area



Massive Childhood Lead Poisoning

The Price of Nigerian Gold

Childhood lead poisoning on a scale unheard of for decades has been detected in rural northwestern Nigeria [*EHP* 120(4):601–607; **Dooyema et al.**]. The culprit: lead in gold ore processed using artisanal techniques. Chelation therapy for hundreds of children, soil replacement, and an education campaign to discourage processing ore inside homes may now have radically reduced child mortality in the hardest-hit villages, but the long-term effect of lead poisoning on the surviving children remains to be seen.

The outbreak surfaced in the spring of 2010 when health professionals noticed abnormally high rates of child illness and death among young children in 4 villages of Zamfara State. Blood tests on 8 children returned blood lead levels (BLLs) of 168–370 mg/dL, at least 16 times the



the 2 worst-affected villages.

Blood samples were collected from 59% of children under age 5. Of these, 97% had BLLs of at least 45 mg/dL, the threshold at which the CDC recommends chelation therapy. The BLLs of 85% surpassed the portable sampling devices' maximum detection limit of 65 mg/dL.

A survey of the villagers revealed that 25% of all children under age 5 had died in the previous year, most of them in the half-year before the study. This translates to a mortality rate of 255/1,000 live births, compared with a national average of 157/1,000. The problem was the lead-contaminated gold ore being processed in many of the family compounds. Two-thirds of these families had started the activity within the last year.

Soil samples were collected from nearly all the family compounds where processing occurred, with 85% showing heavy lead contamination. The worst reached 250 times the U.S. Environmental Protection Agency safety limit of 400 ppm for play areas. Similarly, water lead concentrations far exceeded U.S. recommendations.

Not every child's blood could be tested, and a lack of medical data for the deceased meant their deaths could not be definitively linked to lead poisoning. Further, the locally recruited survey staff had limited training in

of contaminated gold ore.

Adrian Burton is a biologist living in Spain who also writes regularly for *The Lancet Oncology*, *The Lancet Neurology*, and *Frontiers in Ecology and the Environment*.

Massive Childhood Lead (Pb) Poisoning in 2010 "The Price of Nigerian Gold", EHP 120(4)



What is necessary for environmental research in Africa?

Actually, there is little report on environmental pollution in African countries.

- **Know the current pollution levels.**
- **Know the effects of each pollutant on human and wildlife health.**

Field Toxicological approach



Collaboration in Environmental Toxicological Research Field

- Collaborative research
- Researcher Exchanges
- Training
- International Symposium
- etc.

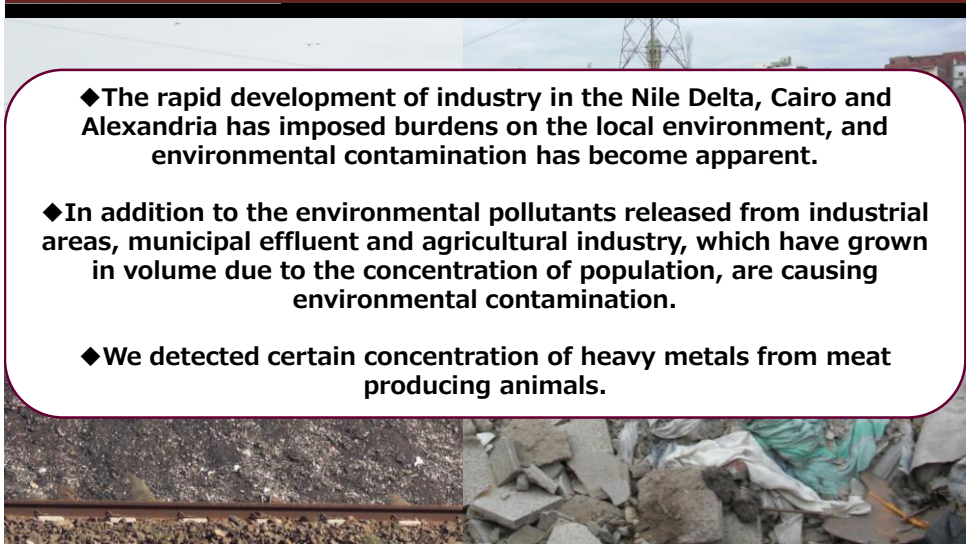





Since 2008, we have started collaborative research with University of Zambia, and we expanded our activities to other African countries.



Food contamination in Egypt



◆The rapid development of industry in the Nile Delta, Cairo and Alexandria has imposed burdens on the local environment, and environmental contamination has become apparent.

◆In addition to the environmental pollutants released from industrial areas, municipal effluent and agricultural industry, which have grown in volume due to the concentration of population, are causing environmental contamination.

◆We detected certain concentration of heavy metals from meat producing animals.

Gold mining areas in Ghana

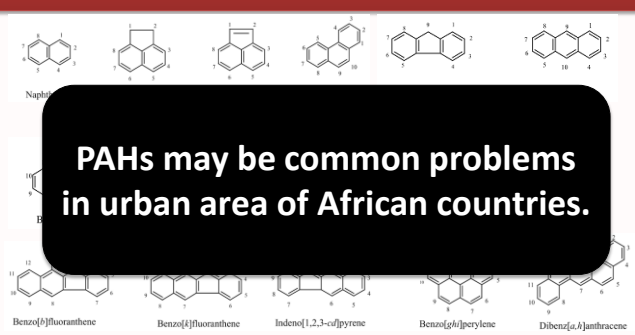
◆At the start of this research, we suggested that this area may be contaminated with mercury, since there are illegal mining activities using mercury.

◆However, in fact, we found the arsenic is the serious problems in this area. Even the drinking water is also contaminated high concentration of arsenic.



In addition to As….
PAHs in Ghana

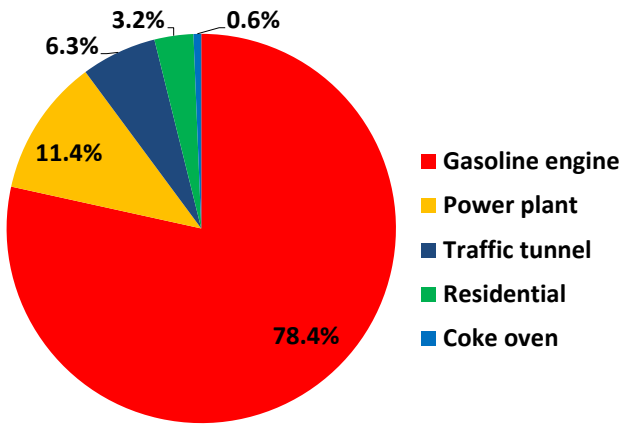
- Air and soil are subjected to different pollutants due to agricultural, industrial or transport activities.
- PAHs (polycyclic aromatic hydrocarbons) are environmental pollutant.



PAHs may be common problems in urban area of African countries.



Source of air PAHs: Chemical mass balance (CMB)



CMB for sources of PAHs in air from the city centre

84.7% of PAHs from city centre were from traffic related sources of which 78.4% was contribution from gasoline engines and 6.3% from roadway traffic.

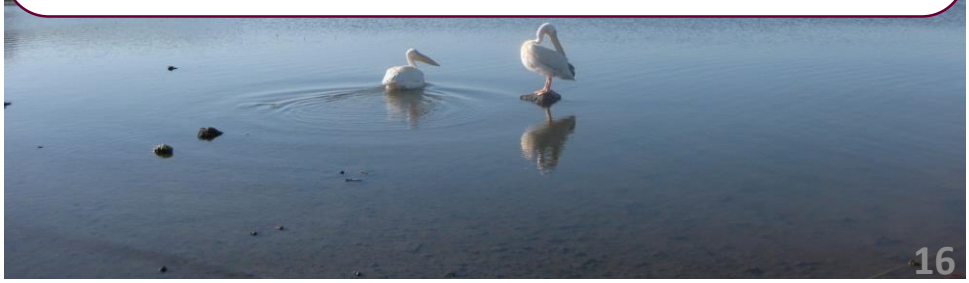


Lakes contaminated with DDTs in Ethiopia

◆Increasing environmental pressure on the Lake by the intensive agricultures and vast growth of floriculture, industrial activities and house hold wastes around the Lake, in Ethiopia.

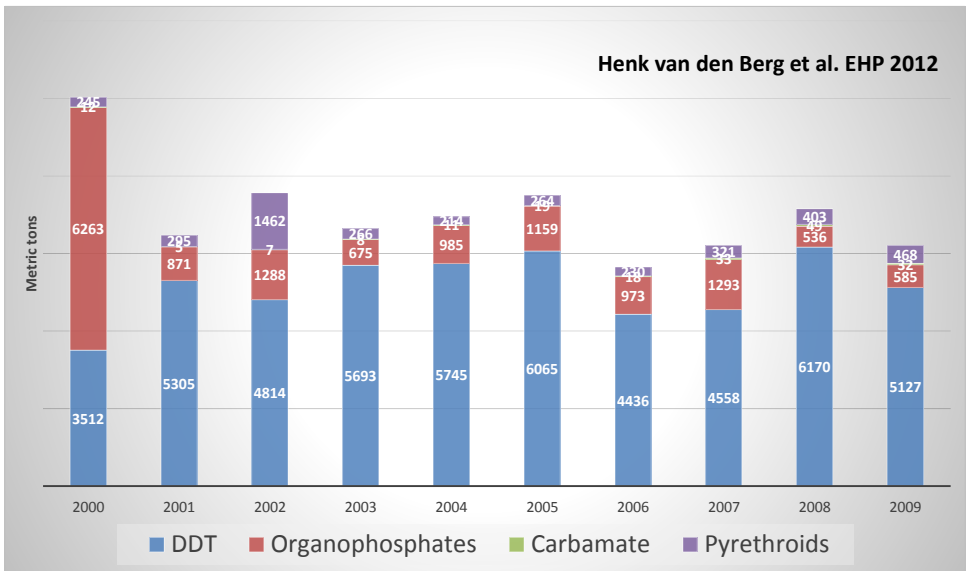
◆We easily detected DDT accumulation in almost fish species in lakes.

◆But…Why?





Insecticide use for vector control; Major pesticide is "DDT"





Global DDT use; especially in Asia and Africa

Annual global production and use of DDT (in 10^3 kg active ingredient)

Country	2003	2005	2007	Comment
Produce DDT for vector control				
China[a]	450	490	NA	For export
India[b]	4,100	4,250	4,495	For malaria and leishmaniasis
DPRK	NA	NA	5	>155 metric tons for use in agriculture
Global production	>4,550	>4,740	>4,500	
Use DDT for vector control				
Cameroon	0	0	0	Plan to pilot in 2009
China	0	0	0	Discontinued use in 2003
Eritrea	13	15	15	Epidemic-prone areas
Ethiopia	272	398	371	Epidemic-prone areas
Gambia	0	0	NA	Reintroduction in 2008
India	4,444	4,253	3,413	For malaria and leishmaniasis
DPRK	NA	NA	5	>155 metric tons used in agriculture
Madagascar	45	0	0	Plan to resume use in 2009
Malawi	0	0	0	Plan to pilot in 2009
Mauritius	1	1	<1	To prevent malaria introduction
Morocco	1	1	0	For occasional outbreaks
Mozambique	0	308	NA	Reintroduction in 2005
Myanmar	1	1	NA	Phasing out
Namibia	40	40	40	Long-term use
Papua New Guinea	NA	NA	0	No recent use reported
South Africa	54	62	66	Reintroduction in 2000
Sudan	75	NA	0	No recent use reported
Swaziland	NA	8	8	Long-term use
Uganda	0	0	NA	High Court prohibited use, 2008
Zambia	7	26	22	Reintroduction in 2000
Zimbabwe	0	108	12	Reintroduction in 2004
Global use	>4.953	>5.219	>3.950	

Produce: 5000 tons
Ethiopia: 400 tons
South Africa: 70 tons
Of DDT is used for IRS

EHP, 2009, 17(11) 1656-63

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We detected high concentration of DDT in wildlife at National Park





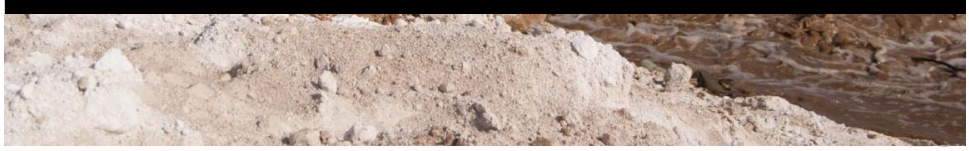
- Tiger fish and avian birds are top predator in river environment.
- We detected marked high concentration of DDT in these animals at National Park in South Africa and Lakes in Ethiopia.

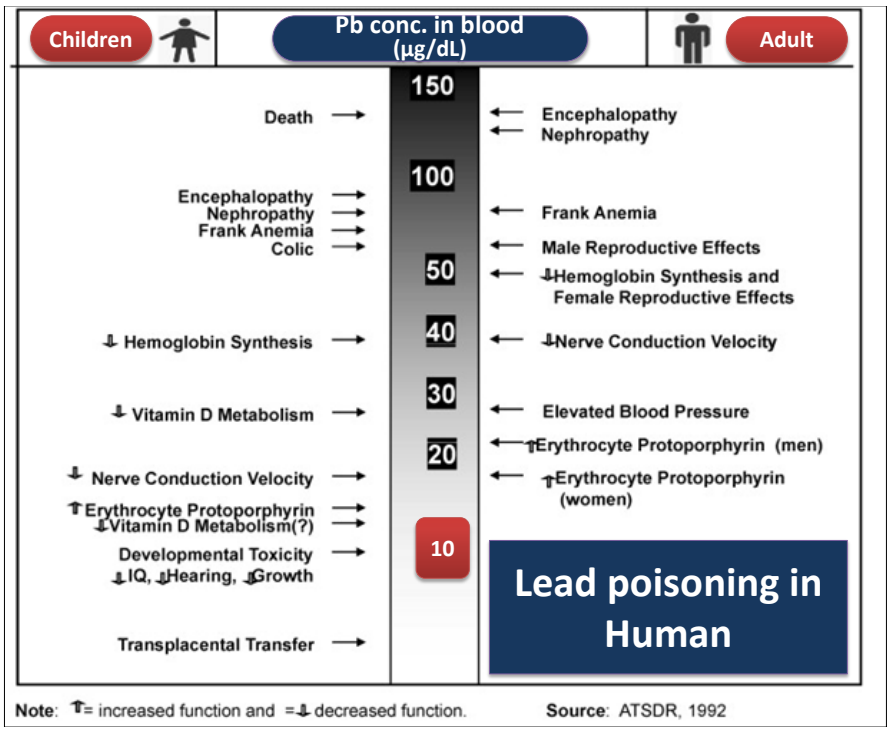
Mining area in Zambia

Almost lead poisoning occurs in developing countries.

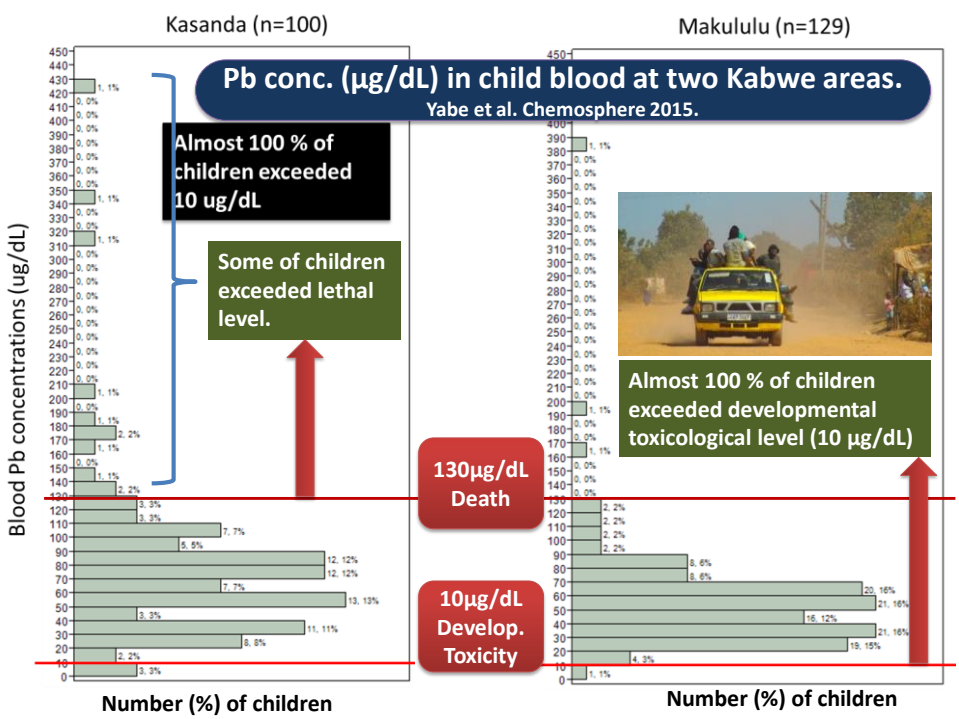


- Our latest research activities revealed that childhood lead (Pb) poisoning is a serious public health concern in Kabwe.

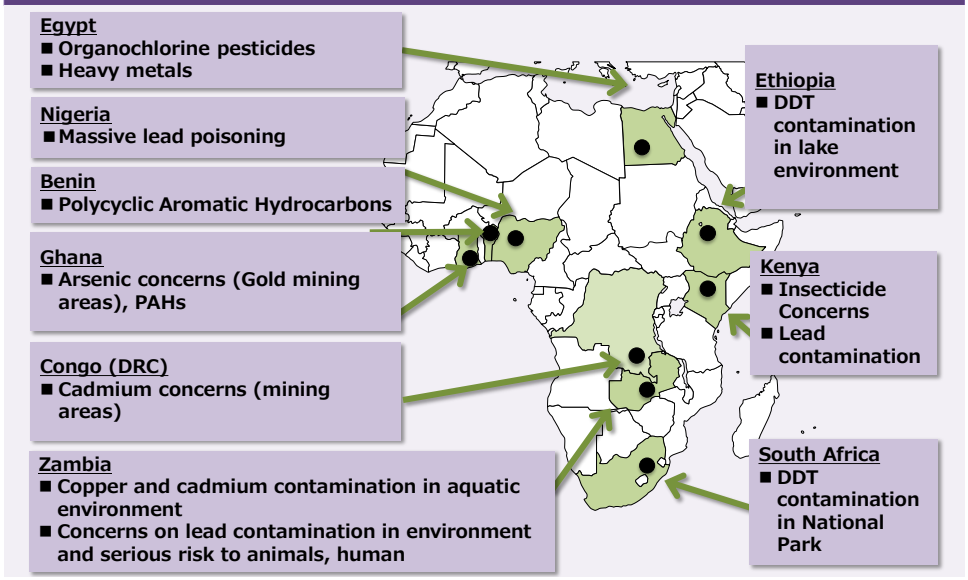



Children
Pb conc. in blood (µg/dL)
Adult
150
100
50
40
30
20
10
Death
Encephalopathy
Nephropathy
Frank Anemia
Colic
Hemoglobin Synthesis
Vitamin D Metabolism
Nerve Conduction Velocity
Erythrocyte Protoporphyrin
Vitamin D Metabolism(?)
Developmental Toxicity
IQ, Hearing, Growth
Transplacental Transfer
Encephalopathy
Nephropathy
Frank Anemia
Male Reproductive Effects
Hemoglobin Synthesis and Female Reproductive Effects
Nerve Conduction Velocity
Elevated Blood Pressure
Erythrocyte Protoporphyrin (men)
Erythrocyte Protoporphyrin (women)
Lead poisoning in Human
Note: = increased function and = decreased function.
Source: ATSDR, 1992

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Kasanda (n=100)
Makululu (n=129)
Pb conc. (µg/dL) in child blood at two Kabwe areas.
Yabe et al. Chemosphere 2015.
Almost 100 % of children exceeded 10 ug/dL
Some of children exceeded lethal level.
Almost 100 % of children exceeded developmental toxicological level (10 µg/dL)
130µg/dL Death
10µg/dL Develop. Toxicity
Blood Pb concentrations (ug/dL)
Number (%) of children
Number (%) of children

Collaborative Research Activity on Environmental Toxicology





International Toxicology Symposium

to discuss on the environmental pollution in African countries

- **International Toxicology Symposium in Africa**
  - 2009~2012 in Zambia
  - 2013 in Ghana
  - 2014~2015 in South Africa
  - 2016 in Egypt



Researcher / Student Exchanges

	2009	2010	2011	2012	2013	2014
Number of researchers	14/125 n / days	33/462	41/620	69/1501	47/1901	36/660
Outbound countries	3 (from JPN)	4 (from JPN)	5 (from JPN)	5 (from JPN)	4 (from JPN)	4 (from JPN)
Symposium Venue	Zambia (Univ of Zambia, Lusaka)	Zambia (Univ of Zambia, Lusaka)	Zambia (Univ of Zambia, Lusaka)	Zambia (Univ of Zambia, Lusaka)	Ghana (KNUST, Kumasi)	South Africa (Johannesburg University and NWU)
Exchange countries	Zambia Ghana Nigeria South Africa Kenya Tanzania	Zambia Ghana Egypt Nigeria South Africa Botswana Kenya Tanzania Benin	Zambia Ghana Egypt Nigeria South Africa Botswana Cameroon Uganda Sudan	Zambia Ethiopia Ghana Egypt Nigeria South Africa Cameroon Sudan Nigeria Kenya Uganda Zimbabwe Burkina Faso Tanzania	Zambia Ethiopia Ghana Egypt Nigeria South Africa Cameroon Sudan Nigeria Kenya Uganda Tanzania Congo (DRC)	Zambia Ethiopia Ghana Egypt Nigeria South Africa Cameroon Sudan Nigeria Kenya Uganda Tanzania

Topics: pesticides, mycotoxin, metals, PAHs, POPs, dioxins, etc…





Research on Environmental Pollution in Africa
Our collaborative research in Future

Project 1 **Continuous surveillance on toxicological impact of environmental pollution in African countries**

Project 2 **International Toxicology Symposium in Africa**

- To share information and establish toxicological network in Africa
- In 2016, Cairo, Egypt

Project 3 **Visualization of impact of chronic / latent chemical hazard and Geo-Ecological Remediation in Zambia**

- KAMPAI project (KAbwe Mine Pollution Amelioration Initiative)
- Hokkaido University: Faculties of Engineering, Veterinary Medicine, Health, Environmental Earth Science , Science. Private Company, etc.
- Collaborative Research and Establishment of “Monitoring Laboratory”



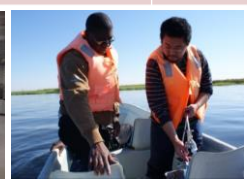
Plan for Capacity building

Common to Asia and Africa

workshop, symposium, short / long training

Requested training from African countries	Target persons	Collaborative faculties of Hokkaido Univ.
● Management	● Officers (Ministry of Mine, Lands)	Engineering
● Chemical analyses ● Monitoring skill, Remote sensing (Surveillance skill using Satellite, GIS) ● Remediation skill	● Officers (Ministry of Mine, Lands, Health, Environment) ● Researchers, MS / PhD Students Monitoring Lab. In Zambia	Faculties of Engineering, Veterinary Medicine, Health, Environmental Earth Science , Science. Private Company, etc.
● Risk assessment, Toxicologist	● Officers (Ministry of Health). Researchers	Faculties of Veterinary Medicine, Health, etc.






Thank you for your kind attention.