UGANDA

A. Regulation on sources

Source of lead	Relevant legislation/regulation	Government agencies	Data source
	No law for lead in paint; currently drafting a lead in paint law. No other standards found at this time for lead.		African Regional Meeting on Eliminating Lead in Paint Recommends 90 ppm Limit, 2019

B. International Agreements

Agreement	Year Ratified
1. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	2003 (a)[1]
2. Rotterdam Convention on the Prior Informed Consent Procedure for certain hazardous Chemicals and Pesticides in international trade	2003
3. Minamata Convention on Mercury	2017
4. Stockholm Convention on Persistent Organic Pollutants	2003

C. Blood lead-level monitoring programs

Details	Data source
1. No details of a national or regional level structured program for blood lead level testing found. However, published studies point to some presence of testing programs at the local level.	1. Refer to section E on scientific papers that perform blood lead-level sampling

[1] Accession (a)

D. Inventory of toxic sites (Toxic Sites Identification Program (TSIP), Pure Earth)

Site	Province/Region	Details (all data comes from the TSIP website)
Lead pollution at Mputa oil exploration Site, Kaiso Tonya, Lake Albert, Hoima District	Western	Mputa oil exploration site is between Kaiso Tonya, a shanty town in western Uganda, and a game reserve. The oil and drilling operations are releasing high concentrations of heavy metals into Lake Albert where residents' fish.
Lead pollution at Ngasa-2 oil exploration well, Angara spit, Kaiso Village, Bugashya County, Hoima District	Western	The oil exploration site is located in Kaiso Village close to a fishing lagoon. The heavy metal contamination originates from the drilling operations and is dispersed on the ground in the adjacent area.
Lead pollution at Kasemene oil and gas drilling site, Kakindo Village, Buliisa District	Western	The oil and gas drilling operations within Kakindo Village polluted the environment with wastewater, contaminating water sources and agricultural fields with lead, chromium, and cadmium.
Lead pollution at Kazinga Village, Kiira Town Council, Wakiso District	Central	Run-off from agricultural activities and lead processing from used lead-acid car batteries is draining into a wetland system in Kazinga Village. Lead has contaminated the soil and water nearby, and threatens Lake Victoria.
Lead pollution from Kantaga Dumpsite, Kampala	Central	Urban soils, roads and wetlands are contaminated by heavy metals from municipal solid wastes.
Lead pollution by Kasese Cobalt Company, Kasese District, Western	Western	Kasese Colbalt Company Limited mines and processes cobalt. The site leeches contaminated sediments high in heavy metals, particularly lead, into Lake George via the Kamulikwizi River. People subsequently drink the contaminated water. Lead dust in the area is also inhaled/ingested by nearby residents.
Lead pollution at Kilembe Mines, Rwenzori mountain, Kasese District	Southern	A closed mine located at the confluence of a river and several streams has released heavy metals, including cadmium, chromium, and primarily lead, into the soil and groundwater. Health effects from lead poisoning are kidney, gastrointestinal and reproductive disorders.

E. Scientific papers on lead exposure (Please contact info@gahp.net for information on studies not in the public domain)

Topic	Authors	Year	Title	Abstract/ description
Blood lead levels	Cusick, Sarah; Jaramillo, Ericka; Moody, Emily; Ssemata, Andres; Bitwayi, Doreen; Lund, Troy; Mupere, Ezekiel	2018	Assessment of blood levels of heavy metals including lead and manganese in healthy children living in the Katanga settlement of Kampala, Uganda	**Background:** Exposure to environmental heavy metals is common among African children. Although many of these metals are known neurotoxicants, to date, monitoring of this exposure is limited, even in countries such as Uganda that are undergoing rapid industrialization. An assessment of the burden and potential causes of metal exposure is a critical first step in gauging the public health burden of metal exposure and in guiding its elimination. **Conclusions:** Heavy metal exposure is prevalent in the Katanga settlement and may limit neurodevelopment of children living there. Future studies are needed to definitively identify the sources of exposure and to correct potential nutritional deficiencies that may worsen metal absorption.
Lead contamination	Mghweno, Leonard; Makokha, Anselimo; Magoha, Happy; Wekesa, John; Nakajugo, Amina	2008	Environmental lead pollution and food safety around Kampala City in Uganda	**Objective:** To determine lead levels in the environment and foods around Kampala city in Uganda and assess its implications to human health. **Methodology and results:** The lead content in samples of soil, water and food was determined by spectrophotometry. The lead content in water samples from Lake Victoria and tap water ranged from 0.32 to 1.25 and 0.09 to 0.19 mg/100ml, respectively. Lead content in soil ranged from 0.17 to 0.88 and from 0.10 to 0.32 mg/100g for samples obtained along the highway, and at least 2 km away from the highway, respectively. The lead content in vegetables grown alongside highways ranged from 0.53 to 0.95, as compared to 0.10 to 0.62 mg/100g for vegetables obtained from markets. **Conclusion and application of results:** The results indicate that there is significant lead pollution in the environment posing a high risk of exposure to people, animals, and plants. The lead content in all the water samples was above the maximum WHO limits. These results are useful in raising awareness about the risk of lead contamination to human health and in the enactment of policies and regulatory measures to limit lead pollution and contamination in foods and the environment in Uganda.

Topic	Authors	Year	Title	Abstract/ description
	Nabulo, Grace; Oryem-Origa, Hannington; Diamond, Miriam	2006	Assessment of lead, cadmium, and zinc contamination of roadside soils, surface films, and vegetables in Kampala City, Uganda	**Abstract:** The relationship between traffic density and trace metal concentrations in roadside soils, surface films, and a selected vegetable weed, Amaranthus dubius Mart. Ex Thell., was determined in 11 farming sites along major highways around Kampala City in Uganda. Surface soil, atmospherically deposited surface films on windows, and leaves of Amaranthus dubius were sampled at known distances from the roads and analyzed for lead (Pb), zinc (Zn), and cadmium (Cd) using flame atomic absorption spectrophotometry. Atmospherically deposited trace metal particulates were sampled using window glass as an inert, passive collector. Total trace metal concentrations in soils ranged from 30.0±2.3 to 64.6±11.7 mg/kg Pb, 78.4±18.4 to 265.6±63.2 mg/kg Zn, and 0.8±0.13 to 1.40±0.16 mg/kg Cd. Total trace metal levels in soil decreased rapidly with distance from the road. Total Pb decreased with distance up to 30 m from the road, where it reached a background soil concentration of 28 mg/kg dry weight. The study found background values of 50 and 1.4 mg/kg for Zn and Cd in roadside soils, respectively. Similarly, Pb concentration in Amaranthus dubius leaves decreased with increasing distance from the road edge. The dominant pathway for Pb contamination was from atmospheric deposition, which was consistent with Pb concentrations in surface films. The mean Pb concentrations in leaves of roadside crops were higher than those in their respective roots, with the highest leaf-to-root ratio observed in the Brassica oleraceae acephala group. The lowest Pb and Zn concentrations were found in the fruit compared to the leaves of the same crops. Leaves of roadside vegetables were therefore considered a potential source of heavy metal contamination to farmers and consumers in urban areas. It is recommended that leafy vegetables should be grown 30 m from roads in high-traffic, urban areas.
Lead exposure	Graber, Lauren; Asher, Daniel; Anandaraja, Natasha; Bopp, Richard; Merrill, Karen; Cullen, Mark; Luboga, Samuel;	2010	Childhood Lead Exposure After the Phaseout of Leaded Gasoline: An Ecological Study of School-Age Children in Kampala, Uganda	**Background:** Tetraethyl lead was phased out of gasoline in Uganda in 2005. Recent mitigation of an important source of lead exposure suggests examination and re-evaluation of the prevalence of childhood lead poisoning in this country. Ongoing concerns persist about exposure from the Kiteezi landfill in Kampala, the country's capital. **Conclusions:** Lead poisoning remains highly prevalent among school-age children in Kampala. Confirmatory studies are needed, but further efforts

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	Trasande, Leonardo			are indicated to limit lead exposure from the landfill, whether through water contamination or through another mechanism. Although African nations are to be lauded for the removal of lead from gasoline, this study serves as a reminder that other sources of exposure to this potent neurotoxicant merit ongoing attention.
Lead in dried sewage sludge	Kyayesimira, Juliet; Ssemaganda, Abbey; Muhwezi, Godfrey; Andama, Morgan	2019	Assessment of Cadmium and Lead in Dried Sewage Sludge from Lubigi Feacal Sludge and Wastewater Treatment Plant in Uganda	**Abstract:** Sludge contains organic and inorganic compounds including traces of heavy metals such as lead (Pb), cadmium (Cd), copper (Cu), nickel (Ni), chromium (Cr) and others. These metals restrict the use of sludge in agriculture because their accumulation is harmful to the environment and particularly the food chain. Cadmium and lead are among the most common heavy metals found in municipal wastewater treatment plant sludge. They are capable of bioaccumulation in plant tissues like roots and leaves and are non-biodegradable and therefore they remain in the sludge which is disposed on land or used as fertilizers on farms. The presence of heavy metal pollutants serves as a great threat to soils and also makes plants grown on such soils unfit for animal and human consumption as they may have detrimental effects to animal and human life. For instance, Pb and Cd are known to be human carcinogens. This study therefore aimed to investigate the levels of Cd and Pb in the treated dry sludge from Lubigi Feacal Sludge and Wastewater treatment plant located in Kawempe division, Kampala city, Uganda so as to ascertain its safety for use on agricultural lands. Two batches of samples were collected and analyzed at Government Analytical laboratory in Wandegeya, Uganda. The acid digested sludge samples were analyzed using Atomic Absorption Spectroscopy (AAS) method. The average concentrations of Pb found in collected sludge samples, batch 1 (11.912 mg/kg dm) and batch 2 (5.304 mg/kg dm) were far below the Environment Protection Agency (EPA) maximum permissible concentration (840 mg/kg) for any land application. Cadmium was not detected in all the sludge samples collected; there is an implication that it is either completely absent in the sludge generated by the plant or present but far below detectable levels. The sludge generated from Lubigi fecal sludge and wastewater treatment plant is therefore safe for application on agricultural lands as far as Pb and Cd concentrations are concerned.

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Lead in fish	Andrew, Tamale; Francis, Ejobi; Charles, Muyanja; Naigaga, Irene; Jesca, Nakavuma; Michael, Ocaido; Anne, Katuhoire; Deborah, Amulen	2016	Perceptions about mercury and lead in fish consumed in Lake Albert fishing communities Uganda	**Abstract:** Fish consumption is a lifestyle in fishing communities influenced by individual and communal perceptions. However, information about individual perceptions about fish consumption in the vulnerable fishing community in a developing country is lacking. Without this study, the benefits of fish consumption in a vulnerable community may not be realized. Data collection was executed using key informant interviews and survey structured questionnaires. The key informants include fisheries, community development, veterinary, community and environmental officers. The household heads were the respondents. The Qualitative data was organized and queried using QSR Nvivo 10 and quantitative data analyzed with SPSS version 22. The perceived benefits of eating fish are health, income, nutrition and manhood. The perceived risks are Stigma and ill health. The factors increasing fish consumption are heedless of fish consumption benefits ($p = 0.041$) and household size i.e. number of adults more than seven ($p = 0.020$). Those decreasing are methods of preparation of fish i.e. boiling and frying ($p = 0.019$ and $p = 0.010$) and oblivious about organizations dealing with fishing activities ($p = 0.029$). An awareness campaign is needed to demystify the health benefits and fallacies of fish consumption. The knowledge on individual perceptions associated with fish consumption will increase fish consumption but with fewer risks.
Lead in milk and beef	Natabo, Phyllis; Namubiru, Sarah; Tayebwa, Dickson; Tamale, Andrew; Bamaiyi, Pwaveno	2018	Food Safety Analysis of Milk and Beef in Southwestern Uganda	**Background:** Inorganic pollutants in milk and beef are of major public health concern; however, information in Africa is still limited due to low food safety monitoring practices. In this study, we established levels of lead (Pb), zinc (Zn), cadmium (Cd), copper (Cu), and iron (Fe) in milk and beef and obtained the estimated daily intake (EDI) and incremental lifetime cancer risk (ILCR) as measures of risk to the Ugandan population. **Materials and Methods:** This was a cross-sectional study in which a total of 40 samples of milk and beef were collected from Bushenyi district in southwestern Uganda. Samples were analyzed by atomic absorbance spectrophotometer, and the EDI and ILCR were computed using the US EPA reference values. **Results and Discussion:** Heavy metal concentrations were highest in the order of $Zn > Fe > Pb > Cu$ in milk samples, while in beef samples,

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				concentrations were highest in the order of Zn > Pb > Fe > Cu and no Cd was detected. Furthermore, beef had significantly higher () Pb and Fe concentrations than milk. The EDI was highest in children, and this was followed by very high ILCR levels, showing that milk and beef are not safe for children in Uganda. Bearing in mind that a high HI was shown, beef and milk from these regions are not recommended for consumption especially by children although more studies remain to be conducted. **Conclusion:** Heavy metals in milk and beef of Uganda may predispose the indigenous community to cancer and other health-related illnesses, showing a need for improved food safety screening to promote food safety.
Lead in organ meats	Ogwok, Patrick; Bamuwamye, Michael; Apili, Grace; Musalima, Juliet	2014	Health Risk Posed by Lead, Copper and Iron via Consumption of Organ Meats in Kampala City (Uganda)	**Abstract:** Organ meat is a good source of protein, and some organs, notably the liver and kidney, are rich in vital minerals. In less developed countries, it is highly consumed because of tradition and being inexpensive. However, organ meats may contain high levels of heavy metals. The major objective of this study was to assess the level of risk posed to consumers by lead (Pb), copper (Cu) and iron (Fe) via the consumption of organ meats in Kampala City. Beef, goat and chicken liver, kidney, rumen, intestine, and chicken gizzard from five major markets in Kampala were assessed for levels of Pb, Cu and Fe. The heavy metal content was determined by flame and furnace atomic absorption spectrophotometry. Target Hazard Quotient (THQ) was used in health risk assessment to determine carcinogenicity of the samples. The concentration of heavy metals ranged from 0.04 to 1.11 mg/kg for lead; 3.5 x 10-4 to 0.66 mg/kg for copper, and 26.20 to 41.00 mg/kg for iron. The level of lead in the liver, kidney, rumen, intestine and gizzard was higher than the maximum recommended limit (0.5 mg/kg wet weight) according to EFSA. A health risk analysis based on the THQ yielded a value >1 for lead in beef and goat liver and kidney, and goat intestine, and 0.99 in chicken liver. This suggests that consumers would possibly experience significant risk from the consumption of lead through these organs. Regular consumption of offal in Kampala may therefore cause deleterious effects during a lifetime in humans most especially for children and women of child bearing age.

Topic	Authors	Year	Title	Abstract/ description
Lead in water plants	Mugisa, D.J.; Banadda, N; Kiggundu, N; Asuman, R	2015	Lead uptake of water plants in water stream at Kiteezi landfill site, Kampala (Uganda)	**Abstract:** The purpose of this study was twofold: (i) to quantify the lead (Pb) uptake by two water plants reeds (Phragmites australis) and papyrus (Cyperus papyrus) in water stream at Kiteezi landfill site, Kampala (Uganda) and (ii) to compare the two species in Pb uptake downstream. As such, leachate samples were collected at the inlet and outlet of the waste water treatment plant (WWTP) at Kiteezi landfill site. A total of 6 plant samples of both plant species, P. australis and C. papyrus, were picked from three different sites at intervals of 10, 20 and 30 m taken from the exit point of the WWTP, as the reference point. All samples were taken to the laboratory for analysis in a cool container. The concentration of Pb in the samples was measured using the atomic absorption spectrometer (AAS), Perkin Elmer Model. The obtained data was analyzed using descriptive statistics and two-way Anova. The results showed that there was no significant difference ($P > 0.05$) in the mean Pb content up taken by both plants (reeds and papyrus). Significant quantities of Pb were present in the plants in the range of 1.68 to 5.46 mg/100 g. The removal efficiency of the plants was found to be 12.4 times higher than WWTP. The highest concentrations of Pb were found downstream at a distance of 30 m away from the reference point. Although, the plants were generalized as having equal uptake levels, the two species had different mechanisms with reeds being accumulators and papyrus being excluders. Therefore, reeds are preferable phytoremediators since when harvested by cutting as practiced by some communities in Uganda, the Pb can easily be removed from the environment.

F. Blood testing in National Health Surveys

National Health Survey	Non-Communicable Diseases Risk-Factors Surveillance	Source
Purpose	Determining the prevalence of the non-communicable diseases risk factors that can be interfered such as smoking, unhealthy diets, physical inactivity, high blood pressure, excess	Uganda, Demographic and Health Survey, 2016

	weight and obesity, high blood sugar and high blood fat, and their distribution by age and gender.	
Sample size	112 districts (15 regions) – from the 20,800 households: all women age 15-49; all men 15-54; children age 6-59 months.	
Blood sample testing	Blood sample collection for vitamin A, malaria, and anemia testing.	
Latest round	2016	
Next round	2021 - ongoing	