GHANA

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.		1. Overview of Lead Paint Laws in Africa, Office of Global Affairs and Policy, EPA, 2020

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

[1] Accession (a)

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.

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 from tyre burning in Ashaiman, Peterline, Greater Accra	Greater Accra	The process of extracting copper wires from used and worn-out tyres through burning releases pollutants into the environment which can be found in the soil. This illegal activity is usually done in the night in the midst of a very busy commercial area bordered by a dumpsite where livestock also graze. Houses around the site are affected by the spread of vapor exposing them to inhalation of toxic substances, particularly lead, and also run-off is likely to spread during rainfall. Grazing cattle eat waste on the burning site and cooking and selling of food is done at the site exposing both humans and cattle to chemical contamination.
Lead pollution from e-waste recycling in Agbogbloshie, Accra	Greater Accra	E-waste processing, mainly of old computers and electronic equipment, has contaminated this large industrial scrap site in Accra, Ghana. Various heavy metals, including lead and mercury, are present in the soil of the site.
Lead pollution at Oblogo Municipal Landfill, Greater Accra	Greater Accra	The Oblogo landfill is the main dumpsite for the tons of waste (municipal and household) generated in the city of Accra-Ghana. The landfill generates nuisances such as bad odour, scattering of waste from vehicles carrying waste. Industrial and hospital waste are not pre-treated before disposal into the landfill. The leachate from the landfill flows downstream and contaminates the Densu River which is the main source of drinking water for about half of the populace in Accra, some of whom ingest this water untreated. Residents in the area are also affected by inhalation of toxins from burning that goes on

Site	Province/Region	Details (all data comes from the TSIP website)
		at the site by Scavengers who extract various materials from e-waste contaminating every part of the immediate environs and beyond.
Lead pollution at Anointed Vessel Batik Training Site, Ho Fiave	Volta	The Anointed Vessel batik training Centre is a batik producing factory. The production involves mixing of salt, caustic soda and hydrogen sulphite to wax and design fabrics. Two types of dyes are produced at this site namely reactive dyes and Vat dyes. Dyeing is done in the open as the dyes leach on the floor contaminating the soil and ground water. A mixture of different pollutants are released, however the pollutant of major concern is lead. Workers at the site are exposed to lead through dermal contact and ingest water used in mixing dyes. Residents and livestock drink wastewater at a nearby stream containing dye waste.
Lead pollution from tyre burning and abattoir in Sakaman, Greater Accra	Greater Accra	The site is currently used as a slaughtering area to slaughter all sorts of animals and used car tyres are used to burn their fur.
Lead pollution from abandoned fuel service station, Winneba, Central Ghana	Central	This is an open access abandoned fuel filling station occupied by auto-mechanics and construction workers exposing themselves to the dangers of lead poisoning through dermal contact and inhalation. The oil drenched soil drains into a river 10m west of the site that serves the community during water crises. Surrounding plant species (plantain) and fish in river could bio-accumulate pollutants such as lead, benzene, etc. which could be transferred to the people in the community. Lead, likely from historical use of leaded petrol, is the key pollutant at this site and is being exposed to people via dust inhalation/ingestion.
Lead pollution by abandoned Shang Feng Mining Site, Akyem Soabe, Eastern	Eastern	Shang Feng is a Chinese-owned company that operated as a mining firm in the Akyem Soabe, Asabroase, Toase area. After taking as much of the precious metals away, it left the operational areas in a very unhealthy condition. The streams are very polluted as well as the farmlands of Soabe. The interesting situation is how palm oil producers fetch the same polluted water and use it for the production of palm oil which may end up in any part of Ghana. The key pollutant at this site is lead. People are being exposed via dermal contact and ingestion.
Lead pollution from an abandoned fuel station, Kormantse, Central Ghana	Central	This is an abandoned fuel filling station with mango trees and herbaceous plants growing around its concrete floor. Children use the site as a playground and herbivores are usually seen grazing. The exposed tank poses a risk of releasing heavy metals into the environment causing human exposure through inhalation and dermal contact. There is also the risk of oil leaking into the soil that could be taken up by plants resulting in bioaccumulation of lead pollutants during run offs.

Site	Province/Region	Details (all data comes from the TSIP website)
Lead pollution at Butuah Lagoon, NewTakoradi, Western Ghana	Western	Local residents who consumed fish from the lagoon suddenly fell ill and many (hundreds) had to be hospitalized. Thousands of fish suddenly died. The Ghana EPA stepped in to close the site and took water and soil samples for analysis.
Lead pollution in Abekoase, Tarkwa-Nsuaem municipality	Western	Mine waste has been dumped on a hill near the community by a mining company. the company's mining activities such as blasting, crushing and extraction cause thick fugitive toxic dust to migrate from the hill (mine site) and settle on the community. Pollutants from the fugitive dust produced uphill include lead, mercury, arsenic and chromium. Possible pathways include inhalation, dermal and ingestion.
Lead pollution at Ayigya municipal dumpsite, Ashanti	Ashanti	In Ghana like many other African Countries, waste separation and possible recycling is not practiced. often mingled waste containing, organic, industrial, plastic and in some cases, medical waste is dumped together on these open fields where possible waste collection is done. such is the case of Ayigya Zongo waste Dumpsite. The leaching from this area flows downstream and possibly contaminate downstream river bodies, and in the case of Ayigya dumb site, such a stream is also used to water cabbage vegetable farm that is cultivated on an abandoned area very close to the current waste dump site. the site is not protected by a wall or any other protection.
Lead pollution in Buokrom/ Doti dumpsite, Kumasi, Ashanti Region	Ashanti	This is a decommissioned waste dumpsite in Buokrom/Doti/Kwabre-Truba in kumasi. this site has been sold to a private developer who has started building on the land and at the foundation level. it is suspected that because it previously was a dumpsite and not properly managed, heavy metals such as lead, chromium and arsenic might be present. parts of the old waste have been exposed as a result of excavating the reclaimed site to start the foundation of the house. this is a residential area and the migration routes include blowing dust int the atmosphere, run-off carrying heavy metals into nearby land grown with plantain.
Lead pollution at Amakom Auto-mechanic (Odifor Asare Park), Lobito, Ashanti	Ashanti	Automotive service and repair shops are the largest small quantity generators of hazardous waste. Such is the case of Auto-mechanic industries in Ghana and that is the case of the Auto-mechanic industry located at Odifor Asare park, 700 m away from the Baba Yara Sports Stadium. This Auto repair industry create many different types of waste during their daily operations. These include: used oil and fluids, dirty shop rags, used parts, asbestos from brake pads and waste from solvents used for cleaning parts. In addition, food seller who sells food to these mechanics, operate on the same land with their children as the mechanics and their number in this location is 1/3 the total population of mechanics.

Site	Province/Region	Details (all data comes from the TSIP website)
Abandoned Lead site, Railway Servicing Workshop, Kumasi	Ashanti	This is an abandoned railway service workshop that once serviced trains. the workshop area is suspected to contain heavy metals, including lead, as a result of years of service. it is located in Adum, a suburb of Kumasi. where the workshop used to be has been taken over by squatters and some parts of it used as dumpsites. The whole place is dusty, full of litter, and smells like a dumpsite. Dust can be inhaled/ingested.
Lead pollution at Ahenema Kokoben Dumpsite, Bosomtwe District, Ashanti	Ashanti	A Legacy refuse dump by Kumasi City Council in Ahenema Kokoben contained waste batteries, scrap metals and expired products. The legacy site was covered by soil. Recently, the area has been zone as residential site with people either excavating the refuse to erect building structures or building directly on the legacy site. The waste is leaching lead, and heavy metals into stream. The local people use the stream for irrigation or crop directly on the legacy site. Pathways include dermal contact with contaminated soil and/or inhalation of contaminated dust, ingestion and dermal contact with contaminated water.
ULAB recycling at Bremang, Ashanti	Ashanti	Breman lead acid waste is exposed to the air. In the dry season, powdery lead waste is carried by wind to other places. During the rainy season, runoff and soil erosion are the dominant carriers of the waste to settlements in the valley and the stream within the valley. People may become exposed to lead through dermal contact while farming and dumping waste at the site; participating in construction work at the site and its surroundings. Lead in the soil may enter the food chain through the direct contact with produce. The upper slope is used as educational centre with student population of 1000, which places them at risk of exposure during school hours.
Abandoned pesticide site, Abuakwa Formulation Plant, Kumasi	Ashanti	It is a defunct pesticide formulation plant that has been abandoned. it is suspected that the main waste dump site of the plant is polluted with heavy metals which is carried by wind and run-off into nearby residential areas.
Lead pollution at Ejura Cluster of Artisans, Ejura Sekyeredumase District, Brong-Ahafo	Brong-Ahafo	The Ejura cluster of artisans operates in the middle of the southern vicinity of the old Ejura township among several small housing units, drinking bars, and other residential facilities. It is the main thorough road for residents in the area and poses potential health risks for the residents.

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
Airborne lead levels	Dartey, E; Adimado, A; Agyarko, K	2010	Evaluation of airborne lead levels in storage battery workshops and some welding environments in Kumasi metropolis in Ghana	**Abstract:** Airborne lead levels were assessed in nine workshops, three each from battery, electronic repair, and welding sources within the Kumasi Metropolis in Ghana. Samples were collected at 0, 2.5, and 5.0 m away from the emission source at the workshops during working hours and another at 5.0 m during break hours. Airborne lead particulates were collected and analyzed using the filter membrane technique and flame atomic absorption spectrophotometry, respectively. There were significant differences ($p \leq 0.05$) among the air lead levels from the workshops. Workshop 3b produced the highest significant values of air lead concentrations of 2,820.31 ± 53.89, 2,406.74 ± 71.87, 754.55 ± 72.52, and 549.01 ± 67.30 µg/m3 at distances of 0, 2.5, 5.0, and 5.0 m (break-time measurement), respectively, while workshop 1w significantly produced the lowest air lead concentration values of 261.06 ± 21.60, 190.92 ± 36.90, 86.43 ± 16.26, and 61.05 ± 3.88 µg/m3 at distances of 0, 2.5, 5.0, and 5.0 m (break-time measurement), respectively. The air lead levels reduced with distance from emission source at the workshops. At all the distances of measurement at working hours, the airborne lead levels were higher than the World Health Organization standard of 50 µg/m3 and exceeded the threshold limit values of 100 to 150 µg/m3 recommended in most jurisdictions. Workers and people in the immediate environs were exposed to air lead levels that were too high by most international standards, thus posing a serious threat to their health.
Automobile emissions	Kylander, Malin; Rauch, Sebastien; Morrison, Gregory; Andam, Kwesi	2003	Impact of automobile emissions on the levels of platinum and lead in Accra, Ghana	**Abstract:** Examination of car fleet records in Accra demonstrates an increasing proportion of catalytic converter-equipped cars in the relatively old car fleet (average age 13 years) due to their import from developed countries. However, only leaded petrol is sold in Ghana. Lead anti-knocking additives, which are known to affect catalyst activity and promote thermal sintering and mechanical abrasion, may increase Pt emissions. This possible synergism prompted the concomitant determination of Pb and Pt levels in road dust and roadside soils in Ghana. Both metals followed traffic density with higher concentrations in urban areas compared to remote sites. In urban areas, the range for Pb (365 ± 93 µg g−1 for dust and 291 ± 76 µg g−1 for soil) reflects pre-catalyst levels in Europe and the US, while the range for

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				Pt (39 ± 24 ng g−1 for dust and 15 ± 5.3 ng g−1 for soil) is typical for the same countries. The elevated Pt concentrations were unexpected due to recent introduction of catalysts to Ghana compared to the prolonged use of catalysts in Europe and the US.
Lead-acid batteries	Manhart, Andreas; Schleicher, Tobias	2015	The recycling chain forused lead-acid batteriesin Ghana	**Introduction:** The unsound recycling of lead-acid batteries can cause serious threats to human health and the environment. Due to the toxicity of lead and the sulfuric acid of the batteries, the recycling chain and the applied management practices require a high level of attention in order to prevent impacts such as massive lead contamination of soil and waterbodies as well as exposing of workers and neighboring communities.This paper provides some basic considerations on sources, management and downstream markets of used lead-acid batteries. The majority of information contained in this document was derived during various field studies on the lead-acid battery recycling chain in Ghana. Although the situation in Ghana cannot be extrapolated to other African countries, it seems plausible that some of the characteristics may be found also in other countries with comparable socio-economic situations.Thus, the document is intended to support field investigations in developing countries and emerging economies by sharing core findings from Ghana as well as some general considerations on lead-acid battery recycling.
Lead exposure	NA, Ankrah; AK, Nyarko; Ofosuhene, M; Appiah-Opong, R; Akyeampon, YA	1998	Lead exposure in urban and rural school children in Ghana.	**Abstract:** Human exposure to lead in non-industrial urban areas is commonly ascribed to vehicular combustion of leaded gasoline. This belief is based on results of studies in societies with high vehicular density which show emission of lead fumes into the air by automobiles that use gasoline with high lead content. To assess this view, blood lead levels were evaluated in 11 to 15-year old school children in urban and rural communities of the Greater Accra Region, Ghana. Blood lead levels was significantly higher in all the urban children studied (mean +/-SD: 8.3+/- 12.7g/dl) than in their rural counterparts (4.0+/-7.2g/dl) (P<0.002). The trend was the same when only those who tested positive for blood lead were considered (24.1+/-9.2g/dl, urban compared with 14.6+/- 5.8g/dl, rural). The prevalence of lead exposure was, however, not significantly different between the two groups (34.3. percent, urban and 27.1 per cent, rural). The presence of anaemia

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				and/or increased urine total protein levels was unrelated to the blood lead levels in the children form both communities. Although a set goal to achieve lead free gasoline is desirable, the closeness of the prevalence rate of lead exposure obtained in the study indicate that factors other than leaded gasoline may be important determinant in exposure to lead in the Ghanaian community.
Lead in blood	Amankwaa, Ebenezer; Tsikudo, Kwame; Bowman, Jay	2017	'Away' is a place: The impact of electronic waste recycling on blood lead levels in Ghana	**Abstract:** E-waste recycling remains a major source of livelihood for many urban poor in developing countries, but this economic activity is fraught with significant environmental health risk. Yet, human exposure to the toxic elements associated with e-waste activities remains understudied and not evidently understood. This study investigates the impact of informal e-waste processing on the blood lead levels (BLLs) of e-waste workers and non-e-waste workers (mainly females working in activities that serve the Agbogbloshie e-waste site), and relates their lead exposure to socio-demographic and occupational characteristics. A total of 128 blood samples were analysed for lead levels. Surprisingly, the mean BLL (3.54 µg/dL) of non-e-waste workers was slightly higher than that of e-waste workers (3.49 µg/dL), although higher BLLs ranges were found among e-waste workers (0.50–18.80 µg/dL) than non-e-waste workers (0.30–8.20 µg/dL). Workers who engaged in e-waste burning tended to have the highest BLLs. In general, the BLLs are within the ABLES/US CDC reference level of 5 µg/dL, although 12.3% of the workers have elevated BLLs, i.e. BLL ≥ 5 µg/dL. The study concludes that the impact of e-waste recycling is not limited to workers alone. Traders and residents within the Agbogbloshie enclave are equally at risk through a range of environmental vectors. This calls for increased public awareness about the effects of human exposure to lead and other toxic elements from e-waste recycling. A key contribution is that government and stakeholder projects for safe e-waste infrastructure should disaggregate the e-waste value chain, recognize differential risk and resist one-size-fits-all strategies.
	Obiri, Samuel; Yeboah, Philip; Osae, Shiloh; Adu-Kumi, Sam	2016	Levels of arsenic, mercury, cadmium, copper, lead, zinc and manganese in	**Abstract:** Human beings working or living near an industrial site where toxic chemicals such as As, Hg, Cd, Cu, Mn, Pb, Zn and or their compounds are used or indiscriminately discharged into the environment, are constantly exposed to such chemicals via ingestion (drinking or eating), dermal contact

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			serum and whole blood of resident adults from mining and non-mining communities in Ghana	or inhalation (breathing). However, in developing countries such as Ghana, limited data on levels of the aforementioned chemicals in whole blood and serum of human beings as a result of exposure to the aforementioned chemicals from mining communities and non-mining communities is preventing effective policy formulation to protect human health. Hence, this study was undertaken to measure the levels of the aforementioned toxic chemicals in whole blood and serum of 300 resident adults from mining (Tarkwa Nsuaem Municipality Assembly (TNMA) and Prestea Huni Valley District (PHVD)) and non-mining (Cape Coast Metropolis) communities in Ghana, using neutron activation analysis (NAA). Blood samples were taken from 200 resident adults (105 males and 95 females) from mining and 100 resident adults (60 males and 40 males) from non-mining communities in the study area following the completion of an informed consent and the issuance of ethical clearance by the Ghana Health Service Ethical Committee. The mean concentrations for As, Hg, Cd, Cu, Mn, Pb and Zn in whole blood of residents from mining communities were as follows: 38 ± 320 µg/L, 63 ± 0.23 µg/L, 303 ± 117 µg/L, 3300 ± 953, 195 ± 90 µg/L, 28 ± 14 µg/L and 1405 ± 458 µg/L, respectively; while the levels of measured toxic chemicals in the serum of resident adults from mining communities were as follows: 65 ± 14 µg/L, 358 ± 22 µg/l, 134 ± 12 µg/L, 3590 ± 254 µg/L, 401 ± 113 µg/L, 58 ± 5.8 µg/L and 49 ± 31 µg/L, respectively, for As, Hg, Cd, Cu, Mn, Pb and Zn and were found to have exceeded the permissible WHO guideline values.
Lead in breast milk	Bentum, John; Addo, Epton; Essumang, David	2010	Lead, Cadmium and Arsenic in breast milk of lactating mothers in Odumanse-Atua community in Manya Krobo district of eastern region of Ghana	**Abstract:** With the recent introduction of the policy of absolute breast feeding of infants in Ghana for the first six months after birth, this triggered our interest in investigating the presences of some heavy metals in breast milk. Breast milk samples were collected from twenty lactating mothers below the ages of twenty five in the Odumanse-Atua community in the Manya Krobo district of Eastern Region of Ghana. The samples obtained by self milking into sterilized polyethylene bottles and well labeled. Few drops of 0.1 M trichloroacetic acid were added to the sample and the aqueous layer heated at 500 0C for one hour. After ashing, it was digested with 0.5 M HNO3 and the metals analyzed using an AAS (Philip AAS 9200U model). The mean level of Pb was 4.33 µg/L with a range of < LOD -32.0 µg/L. The mean level of Cd was found to be 1. 34 µg/L

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				and range < LOD -12.301 µg/L. The mean arsenic concentration was 1.54 µg/L and ranging between < LOD - 6.22 µg/L.
Lead in children	Obiri, S; Dodoo, D.K.; Armah, F.A.; Essumang, D.K.; Cobbina, S.J.	2010	Evaluation of lead and mercury neurotoxic health risk by resident children in the Obuasi municipality, Ghana	**Abstract:** This study assesses neurotoxic effects associated with exposure to lead and mercury in borehole, tap and surface water by resident children in the Obuasi municipality in accordance with USEPA risk assessment guidelines. From the results of the study, the hazard quotient for oral ingestion of mercury in tap water in Obuasi is 7.4 and 15 respectively via both central tendency exposure (CTE) and reasonable maximum exposure (RME) parameters, respectively. This means that approximately 7 and 15 (by both CTE and RME parameters, respectively) resident children in Obuasi are likely to show neurologic effects associated with exposure to mercury and lead such as increased nervousness, loss of memory and/or decrease in concentration, impaired writing ability and tremor.
Lead in e-waste	Wittsiepe, Jurgen; Feldr, Torsten; Till, Holger; Burchard, Gerd; Wilhelm, Michael; Fobil, Julius	2017	Pilot study on the internal exposure to heavy metalsof informal-level electronic waste workers in Agbogbloshie,Accra, Ghana	**Abstract:** Informal-level electronic waste (e-waste)-process-ing activities are performed at hotspots in developing coun-tries such as India, China, and Ghana. These activities increasethe ambient burden of heavy metals and contribute to the toxicexposure of the general population. However, few data existon the internal exposure of populations involved in these in-formal activities and in close contact with fumes from thedirect combustion of electronic waste products in these coun-tries. Therefore, in a cross-sectional study design, we analyzedblood, urine, and hair samples from 75 e-waste workers resid-ing in and/or working on a large e-waste recycling site inAgbogbloshie, Accra, Ghana, and compared the resultsagainst those of 40 individuals living in a suburb of Accrawithout direct exposure to e-waste recycling activities.
	Caravanos, Jack; Clark, Edith; Fuller, Richard; Lamberston, Calah	2011	Assessing Worker and Environmental Chemical Exposure Risks at an e-Waste Recycling and Disposal Site in Accra, Ghana	**Background:** It is estimated that 20–50 million tons of electric and electronic waste (e-waste) is generated per year of which 75–80% is shipped to countries in Asia and Africa for recycling and disposal. In these countries recycling of e-waste is performed with limited and often no environmental or worker health precautions. Activities at these sites often pose harmful threats in the form of soil pollution leading to contaminated water and food as well as air contaminants affecting the health of the workers and children at these sites.

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				Objectives: In an effort to better understand the multitude of chemical releases at these sites, an assessment was conducted at a large e-waste recycling and disposal site located in the vicinity of Agbogbloshie Market in Accra, Ghana. **Methods:** Environmental (ambient) air samples and worker breathing zone samples were taken for selected metals. In addition, surface soil samples were collected throughout the site and analyzed for lead (Pb). **Results:** Personal air samples collected from workers and the environment revealed elevated levels for aluminum, copper, iron, lead and zinc. Of the 100 soil samples taken, more than half were above the US Environmental Protection Agency standard for lead in soil. **Conclusions:** The Agbogbloshie e-waste recycling/disposal site in Accra, Ghana revealed an area with extensive lead contamination in both ambient air and topsoil. Given the urban nature of this site e as well as the large adjacent food distribution market, the potential for human health impact is substantial both to workers and local residents.
Lead in soil	Twumasi, Peter; Tandoh, Marina; Borbi, Makafui; Ajoke, Adigun; Owusu-Tenkorang, Emmanuel; Okoro, Roseline; Dumevi, Rexford	2016	Assessment of the levels of cadmium and lead in soil and vegetable samples from selected dumpsites in the Kumasi Metropolis of Ghana	**Abstract:** Many dumpsites in the urban communities in Ghana are used for cultivation of crops, especially vegetables. However, these dumpsites may serve as potential sources of soil heavy metals that could enter the food chain mainly through cultivated food crops with serious consequences on human health. This study investigated the levels of two heavy metals, lead (Pb) and cadmium (Cd), in the soil and tissues of vegetables grown on such dumpsites. Soil and tissue (lettuce, cabbage, spring onion, tomato and the leaves of Xanthosoma sagitifolium) samples were collected from ten locations with two of these locations used as control. The samples were acid-digested and the metal concentrations determined using atomic absorption spectrometry. Pb and Cd contents of soils from all the eight dumpsites and one of the control locations were above the guidelines recommended by FAO and WHO. The highest Cd level in the soil (13.6 mgkg-1 of Cd) was found at Aketego dumpsite and the highest soil Pb (36.1 mgkg-1 Pb) was recorded at Meduma dumpsite. The leafy vegetables, cabbage, lettuce and X. sagitifolium (locally called 'kontomire') recorded relatively

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				higher amounts of Pb and Cd in the edible parts. Further studies are required to determine how much of the daily diet these vegetables contribute to the total diets of the population and special attention to calculating the overall daily doses of Cd and Pb to pregnant mothers and children <5 years of age is thus warranted.
	Aboh, Innocent; Sampson, Manukure; Nyaab, Leticia; Caravanos, Jack; Ofosu, Francis; Mensah, Harriet	2013	Assessing Levels of Lead Contamination in Soil and Predicting Pediatric Blood Lead Levels in Tema, Ghana	**Background:** Tema, Ghana's main industrial city, has many areas that are suspected to be contaminated by lead. Elevated lead levels can affect, among many other issues, mental development, kidney function and blood chemistry. Children are particularly at risk. **Objectives:** The objective of this study was to determine the concentration of lead in soil from selected sites in Tema and how these levels relate to local pediatric blood lead predictions. **Methods:** A total of 47 surface soil samples were taken from 9 different sites. Energy dispersive X-ray technique was employed to determine the levels of lead. Pediatric blood lead levels were estimated using the Integrated Exposure Uptake Bio-Kinetic Model For Lead in Children, developed by the U.S. EPA. **Results:** The study revealed that the selected sites are highly contaminated by lead. In particular, the concentration of Pb in soil at a used lead acid battery recycling facility exceeded regulatory limits for industrial soil as set by the U.S. EPA. The model for predicting concentrations of lead in the blood of age-specific children showed extremely high probabilities of BLLs exceeding regulatory limits. **Conclusions:** Based on the results of soil testing, sites that were expected to reveal lead exposure positively demonstrated high levels of contamination, in some areas exceeding U.S. and other national regulatory limits. This information is expected to help authorities make informed clean-up decisions.
	Bentum, J.K.; Adotey, J.P.K.;	2011	Assessment of lead, copper and zinc	**Abstract:** The extent of heavy metal contamination viz. lead (Pb), copper (Cu) and zinc (Zn) in the soil of the University of Cape Coast School of

Topic	Authors	Year	Title	Abstract/ description
	Koka, J; Koranteng-Addo, E.J.; Yeboah, A; Boamponsem, L.K.		contamination of soil from University of Cape Coast School of Agricultural farmland, Ghana	Agricultural farmland, Ghana, were assessed. Thirty soil samples were taken from six demarcated areas in the farm. The mean metal concentrations (mean ± cv) and ranges of the metals were (5.37 ± 45.44) 1.93- 11.88 for (Pb); (2.52 ± 118.9) 0.04-24.63 for (Cu); (475.87 ± 26.54), 135.6-887.01 and for Al, (393.83 ± 33.38) 138.32-1051.56. The results showed that the metal concentrations in the soil at six sites decreased in the order: Zn > Pb >Cu. The variation in the distribution of the metals in the soil was found to be in the order Cu > Pb > Zn. The enrichment factor indicated that the soil was enriched with the metals, and the extent of enrichment was in the order, Zn > Pb > Cu. The geoaccumation index and the mean enrichment quotient indicated that the soil was polluted. This contaminated soil sediments could act as a source of pollutant for crops grown in the farm.
Lead in spices	Nkansah, Marian; Opoku Amoako, Cosmos	2010	Heavy metal content of some common spices available in markets in the Kumasi metropolis of Ghana	**Abstract:** In recent years, there has been a growing interest in monitoring heavy metal contamination of spices. The concentrations of some heavy metals (lead, zinc, nickel, copper, iron, and mercury) in 15 common spices available at local markets in the Kumasi Metropolis were determined using Atomic Absorption Spectroscopy (AAS) from October, 2008 to February, 2009. The study showed differences in metal concentrations according to the edible part (root, stem, leaf, and fruit). The range of the concentrations of metals in dry weights were; Lead 0.1153 - 0.0973 g/kg, Zinc 0.074 - 0.059 g/kg, Nickel 0.0735 - 0.0593 g/kg, Copper 0.0210 - 0.009 g/kg, Iron 0.4942 - 0.1100 g/kg, Mercury 1.300*10-6 - 2.493*10-5 g/kg respectively. Most of the levels in the spices were acceptable with the exception of lead which was above the standard limit approved by WHO and FAO for some of the samples. Consumers of these spices would not be exposed to any risk associated with the daily intake of 10g of spices per day as far as metals; Zinc, Nickel, Copper, Iron and Mercury are concerned. However Lead levels in Ginger, Negro pepper and Cinnamon were above the standard value of 0.1 g/kg. Generally most of the spices available on the market are safe for human consumption as far as trace metal levels are concerned.
Lead in water	Cobbina, Samuel; Nkuah, Daniel; Tom-	2013	Non-cancer risk assessment from exposure to	**Abstract:** The study assessed non-cancer human health risk from exposure to mecury (Hg), cadmium (Cd), arsenic (As), copper (Cu), and lead (Pb) in surface and groundwater in Tinga, in the Bole-Bamboi District. A total of 42

Topic	Authors	Year	Title	Abstract/ description
	Dery, Damian; Obiri, Samuel		mercury (Hg), cadmium (Cd), arsenic (As), copper (Cu) and lead (Pb) in boreholes and surface water in Tinga, in the Bole-Bamboi District, Ghana	water samples were collected for a period of six months. Mean concentration of Hg, Cd, and Pb were found to be (0.050 ± 0.04 mg/L), (0.031 ± 0.02 mg/L) and (0.07 ± 0.05 mg/L), respectively. These were all above the World Health Organization (WHO) recommended guideline values for drinking water. Non-cancer human health risk as a result of exposure to Hg and Cd through ingestion of borehole water was found to be high. Hazard quotients (HQ) as a result of exposure to mercury for adults and children ranged from 2.5 to 30 through central tendency exposure (CTE) and 4.6 to 60 through reasonable maximum exposure (RME). For Cd, CTE ranged from 0.96 to 2.7 and RME ranged from 1.8 to 5.4. The HQ for exposure to Hg and Cd through ingestion of ground water exceeded the acceptable United States Environmental Protection Agency (USEPA) value of 1.0. This implies that resident children and adults are likely to develop diseases (such as low intelligent quotient, tremor, kidney failure, increased hypertension and cardiovascular diseases) associated with long term exposure to Hg and Cd.
	Orbi, Samuel	2007	Determination of Heavy Metals in Water from Boreholes in Dumasi in the Wassa West District of Western Region of Republic of Ghana	**Abstract: Concentrations of heavy metals in the borehole at Dumasi in the Wassa** West District of the Republic of Ghana have been measured in this study. The concentrations of the following metals in the ground water from Dumasi borehole are: Iron (Fe) – 7.52 ppm, Manganese (Mn) – 1.11 ppm, Arsenic (As) – 4.52 ppm, Chromium (Cr) – 0.026 ppm, Cobalt (Co) – 0.01 ppm, Zinc (Zn) – 0.007 ppm, Cadmium (Cd) – 0.002 ppm and Lead (Pb) – 0.005 ppm. The results of the study show that resident adults and children who use water from the boreholes are at serious risk from exposure to health hazards associated with exposure to the above metals in the boreholes in Dumasi. If the results of this study are applied to other mining communities, which lie on the Birimian and Tarkwaian rock system, then the residents are at serious risk from exposure to toxic metals from drinking water from the boreholes dug for them by mining companies operating in their communities.
Lead in vegetables	Lente, Ishmael; Keraita, Bernard; Drechsel, Pay;	2012	Risk Assessment of Heavy-Metal Contamination on Vegetables Grown	**Abstract:** Assessment was done of heavy-metal contamination and its related health risks in urban vegetable farming in Accra. Samples of irrigation water (n=120), soil(n=144) and five different kinds of vegetable (n=240)were collected and analyzed for copper, zinc, lead,

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	Ofosu-Anim, John; Brimah, Abdul		in Long-Term Wastewater Irrigated Urban Farming Sites in Accra, Ghana	cadmium, chromium, nickel and cobalt. All water, soil and vegetable samples contained detectable concentrations of each of the seven heavy metals except for irrigation water which had no detectable chromium, cadmium and cobalt. All heavy-metal levels were below permissible limits except lead on vegetables which was 1.8–3.5 times higher. Health risk assessments showed for all elements that normal consumption of each of the vegetables assessed poses no risk. The highest hazard index obtained was 42 % for wastewater irrigated cabbage. Though within permissible limits, cabbage and ayoyo had the highest potential risk. Compared with previous studies on the same sites, the data show that the risk from heavy metals is less significance than that from pathogen contamination which has positive implications for risk mitigation.

F. Blood testing in National Health Surveys

National Health Survey	Non-Communicable Diseases Risk-Factors Surveillance	Source
Purpose	To measure the extent of ownership and use of mosquito bed nets; to assess coverage of intermittent preventive treatment to protect pregnant women; to identify practices and specific medications used for treating malaria among children under age 5; to measure indicators of behavior change communication messages, knowledge, and practices regarding malaria; to measure the prevalence of malaria and severe anemia among children age 6-59 months.	Ghana, Malaria Indicator Survey, 2019
Sample size	Women age 15-49; children age 6-59 months from a selected fixed 30 households.	
Blood sample testing	Anemia and malaria testing through blood samples.	
Latest round	2019	
Next round	-	