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# Tracking waste:

## What really happens to our electronic devices

by Vincent Kyere, Sampson Atiemo and Klaus Greve

ZEF research in brief

In 2013, the world generated a total of 48 million tons of discarded Electrical Electronic Equipment (EEE). This is also known as Waste Electrical Electronic Equipment (WEEE) or electronic waste (e-waste). The list of wasting nations is topped by the US, followed by China and the EU with 9.4, 7.9 and 6.5 million tons, respectively (Step Initiative, 2013). Although the so-called Basel Convention classifies e-waste as hazardous and as such bans its transboundary movement across countries, exporters and importers ship these discarded EEE under the disguise of cheap secondhand EEE or as charity EEE in developing countries. Ghana imported a total of 215,000 tons of EEE in 2009, 30 percent of which are new while 70% are used or secondhand EEE. Twenty percent (see fig. 1) of the used EEE are complete waste and destined for disposal or recycling sites (Manhart et al., 2011).

## Goals and set-up of ZEF study

This study focuses on providing empirical evidence on human contamination by multi-trace elements and, more generally, on addressing the challenges of e-waste and regulations in Ghana. Research is to reveal the levels of heavy metal contaminations and critical raw metal lost in the environment, the hotspots, situation of informal recyclers and how GIS tools can be integrated into the decision-making framework of e-waste management in Ghana.

**EEE being unloaded in Tema port, Ghana.**

## First findings

Unregulated informal recyclers use very crude, rudimental and environmentally unsustainable methods such as manual dismantling and open burning to salvage the valuable components of e-waste. This has led to debilitating environmental consequences (such as soil, air, water pollution) and public-health related effects like respiratory diseases at and around these processing and disposal sites in Ghana. Studies revealed high concentration of heavy metals such as As, Pb, Cd and Hg in surface dust and water bodies around e-waste processing sites beyond limits that can cause cancer, neurological and developmental disorders (Asante et al., 2012; Caravanos et al., 2011; Robinson, 2009).

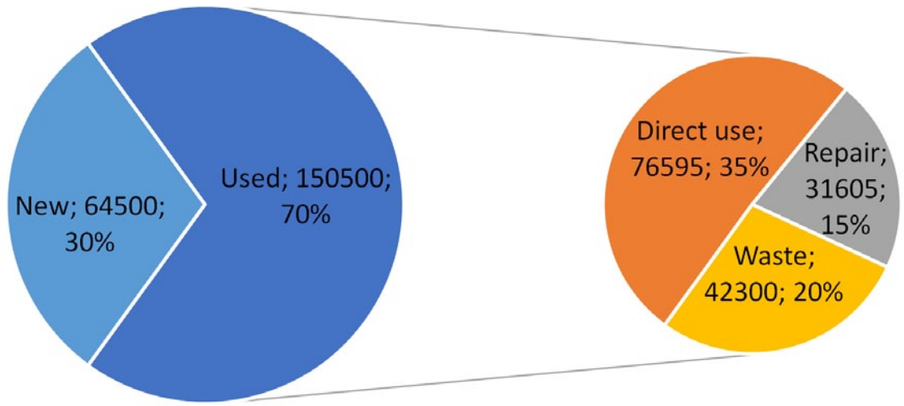


**Figure 1: Tracing electronic equipment in Ghana.**

## Area of research

Although there are several locations of e-waste processing and disposal sites in Ghana, Agbogbloshie (see fig. 2) is the biggest. It is notoriously known as the graveyard for developed countries' electronic waste. The dumpsite is divided into three areas (see figure 2): Weighing Site (WS) Dismantling (DS), Burning Site (BS), and Disposal.

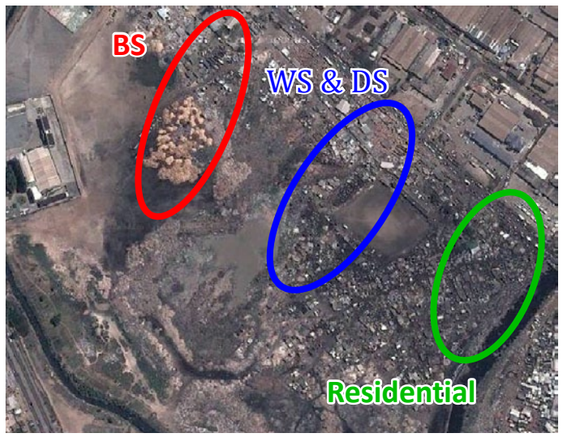


**Figure 2: Agbogloshie near Accra: the research area in Ghana.**

Agbogbloshie is located on the banks of the Odaw River, covers 6.2 hectare (15 acres) and is adjacent to the Agbogbloshie slum - a squatter community of about 40,000 people. There are about 6,400 registered scrap dealers in Agbogbloshie. Next to the dumpsite are residential areas, a commercial area, farms, food markets, recreational sites, a clinic and worship areas.

## Impact of e-waste

The entire life cycle of EEEs significantly impact the environment, human health and economy both positively and negatively.

## Environment

The crude and primitive methods used by informal recyclers contribute to the release of hazardous chemicals such as PAHs, PBDEs, BFRs and trace metals which can pollute soil, water and environment, with subsequent impacts (see table 1). Preliminary results from the study indicate that levels of Cd, Co, Cr, Cu, Ni, Pb and Zn are several times higher than in natural soil.

| Heavy metal | No. obs | Measured concentrations (ppm) | | | |
|---|---|---|---|---|---|
| | | Min | Max | Mean | Std Dev |
| Co | 146 | 8.80 | 153.70 | 47.50 | 30.39 |
| Cr | 146 | 21.00 | 1332.00 | 309.67 | 275.08 |
| Ni | 127 | 0.60 | 4003.00 | 59.80 | 352.95 |
| Cu | 146 | 9.40 | 21980.00 | 1717.92 | 3185.85 |
| Zn | 146 | 41.90 | 15860.00 | 1615.27 | 2287.30 |
| Pb | 146 | 14.20 | 10280.00 | 977.88 | 1734.34 |

**Table1: Heavy metals measured in the research area.**

## Health

According to Leung et al., (2008) children are most vulnerable when being exposed to heavy metal. With children involved and playing at the e-waste processing and disposal sites in Ghana, the threat is even higher. A hazard index composed to assess non-carcinogenic health risk showed that Cr and Pb pose risk (neurological and developmental disorders) to children in all sampling sites within Agbogbloshie (fig. 3).

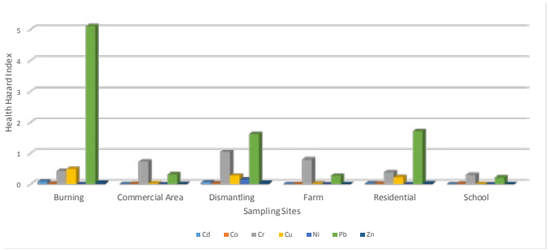


**Figure 3: Non-cancer hazard index for heavy metals**

## Economic aspects

Properly recycled e-waste can generate income and critical secondary raw materials (Schluep et al., 2009). From a ton of mobile phones without batteries one can extract 3.5kg of Ag, 340g of Au, 140g of Pd and 130kg of Cu. Preliminary results indicate some critical rare earth elements such as Ag, Al, Ni are lost due to the processing of the waste stream in Ghana. Nevertheless, the business and industry are vibrant with several livelihoods depending on it.

**Burning cables at Agblogloshie to extract copper.**

## Objectives and preliminary results

- The study is to provide spatial information on the contamination levels within the identified locations, which can support future clean-up decisions.
- IS technology is to support policy-making as an evidence-based decision making tool for e-waste management.
- The study is to identify key drivers and barriers of sound management of WEEE in Ghana.
- Policy alternatives are to be submitted to regulatory authorities.

## Conclusions

- E-waste menace will stay with us as long as we continue to use technology.
- As the digital divide between Africa and the West widens there is an anticipated increase in the flow of second hand EEE into the continent.
- Ghana's ability to successfully manage e-waste significantly depends on: legislation, policy direction, institutional framework, as well as on how successfully these structures and public education can be enforced.
- Any policy solution must take the clear-cut responsibilities of all actors in the e-waste value chain into account.

## References


Asante, K.A., Agusa, T., Biney, C.A., Agyekum, W.A., Bello, M., Otsuka, M., Itai, T., Takahashi, S., Tanabe, S., 2012. Multi-trace element levels and arsenic speciation in urine of e-waste recycling workers from Agbogbloshie, Accra in Ghana. Sci. Total Environ. 424, 63–73. doi:10.1016/j.scitotenv.2012.02.072

Atiemo, S.M., Ofosu, F.G., Aboh, I.K., Kuranchie-Mensah, H., 2012. Assessing the heavy metals contamination of surface dust from waste electrical and electronic equipment (e-waste) recycling site in Accra, Ghana. Res. J. Environ. Earth Sci. 4, 605–611.

Caravanos, J., Clark, E., Fuller, R., Lambertson, C., 2011. Assessing Worker and Environmental Chemical Exposure Risks at an e-Waste Recycling and Disposal Site in Accra, Ghana. J. Health Pollut. 1. doi:10.5696/jhp.v1i1.22

Leung, A.O.W., Duzgoren-Aydin, N.S., Cheung, K.C., Wong, M.H., 2008. Heavy Metals Concentrations of Surface Dust from e-Waste Recycling and Its Human Health Implications in Southeast China. Environ. Sci. Technol. 42, 2674–2680. doi:10.1021/es071873x

Manhart, A., Osibanjo, O., Prakash, S., 2011. Informal e-waste in Ghana, socio-economic impacts and feasibility of international recycling cooperations. Final Rep. Compon. 3.

Robinson, B.H., 2009. E-waste: An assessment of global production and environmental impacts. Sci. Total Environ. 408, 183–191. doi:10.1016/j.scitotenv.2009.09.044

Schluep, M., Hagelueken, C., Kuehr, R., Magalini, F., Maurer, C., Meskers, C., Mueller, E., Wang, F., 2009. Recycling from E-Waste to Resources, Sustainable Innovation and Technology Transfer Industrial Sector Studies. UNEP & Step Initiative, Berlin, Germany.

Step Initiative, 2013. StEP Launches Interactive World E-Waste Map - United Nations University [WWW Document]. URL http://unu.edu/media-relations/releases/step-launches-interactive-world-e-waste-map.html#info (accessed 5.21.14).



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