DISCUSSION PAPER 2/2020

Disincentivising Africa's Digital Dystopia

Economic 'High Roads' to Navigate the E-Waste Debacle

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Strengthening Africa's economic performance

THE BRENTHURST FOUNDATION

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Published in January 2020 by
The Brenthurst Foundation
(Pty) Limited

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Layout and design by
Sheaf Publishing, Benoni.

Executive Summary

E-waste is, at present, the most prolific waste stream in the world, predicted to reach 120 million tonnes by 2050 – of this, a staggering 76% is unaccounted for. Whilst largely undocumented, the illicit shipping of e-waste from developed to developing nations is a widely publicised phenomenon. Despite being signatories of the Basel Convention, poor legislation governing e-waste handling in Nigeria and Ghana have resulted in these countries becoming Africa's major digital dumpsites, with the ports of Lagos and Accra respectively receiving 60 000 and 150 000 tonnes of illicit e-waste annually. In the age of innovation, current trends in digital turnover and consumption point to a continuation along this trajectory. A deficit in formal sector employment opportunities in combination with growing population numbers similarly creates market demand for e-waste within these countries, with urban mining presenting itself as a financially lucrative source of revenue.

This discussion paper argues that, while economics may be driving the current globalisation of e-waste, it too may provide insights into how Africa's electronic epidemic may be overcome. The concurrent problems of mounting e-waste, rising resource scarcity and the price instability of various minerals and metals required for electronics production emphasise the need for a transition towards a circular economy. The implementation of market-based mechanisms like Pigouvian tax, PES (payment for ecosystem services), and the institution of land rights to financially incentivise responsible waste handling could additionally prove useful in expediting the shift by providing financial incentives for sound e-waste handling, while the formalisation and governance of the urban mining sector under the under principles of EPR (extended producer responsibility) could incentivise producers to invest in developing the infrastructural capacity for sound recycling in developed nations like Nigeria and Ghana, thereby generating formal sector employment opportunities and just transitions towards sustainability.

Introduction

We find ourselves in the midst of the digital era, where a combination of rapid technological innovations and decreasing production costs have made the possession of electronic goods and digital technologies increasingly accessible to the masses. A case in point – globally, more people own mobile phones than flushing toilets,[1] and the number of devices connected to the internet at a given moment outnumbers that of humans populating the planet.[2] As simple logic in a linear economy would dictate, the rapid increase in the production and consumption of electronic goods is accompanied by rapid increases in incumbent electronic waste (e-waste).

E-waste (defined as obsolete or defunct electrical and electronic equipment [EEE]), is, at present, the most prolific waste stream in the world[3] – the total volume of e-waste is predicted to exceed 52 million tonnes by 2021,[4] and to potentially reach 120 million tonnes by 2050.[5] To make matters worse, only 20% of generated e-waste is recycled. Of the remaining 80%, 4% forms part of household waste, while an overwhelming 76% is unaccounted for (i.e. dumped, traded or recycled under substandard circumstances).[6] Undocumented, whilst legally obscure, does not equate to 'off the radar' – the illicit export of e-waste from developed to developing nations is a highly publicised problem. In Africa, for example, the port cities of Lagos (Nigeria) and Accra (Ghana) are reported to receive 60 000 and 150 000 tonnes of illicit e-waste imports respectively per annum[7],[8] – the aforementioned trends in this sector, therefore, are enough to forecast an electronic epidemic in Africa. Sustainability activists have, for years, lobbied for the developed world to desist from electronic dumping in countries like Nigeria and Ghana. Yet in a world where ever-evolving trends determine product life cycles and a proclivity for consumerism takes precedence over social and environmental consciousness, casting sole blame in such a manner necessitates an unheard-of simplicity in an increasingly complex globalised setting. Intellectual inquiry aimed at pioneering a sustainable path forward needs to navigate an economic bog typified by filthy shades of grey.

Engineered Ecosystems: Africa's Electronic Quagmires

If one were to contemplate the end of the world – what would it look like? Our current technocratic trajectory necessitates little toil of the imagination – one need only look to Accra's Agbogbloshie, the global poster child of the e-waste debacle, to catch a preview of what ultimately could culminate in the end of the Anthropocene – formerly pristine wetlands and swamps transformed into electronic quagmires, clean water customised into chemical cocktails, radioactive earth in which nothing natural can grow, and an altered atmosphere effectively converting the planet into the largest-known gas chamber. This begs the question – in the age of innovation, are we innovating our own demise? And where globalisation facilitates globalised waste, will Africa be amongst the first to suffer?

The rapid increase in the production and consumption of electronic goods is accompanied by rapid increases in incumbent electronic waste

Nigeria and Ghana are recognised as Africa's major e-waste dumpsites.[9] Despite being signatories of the Basel Convention (an international treaty regulating the transboundary movement and disposal of hazardous waste), poor legislation governing e-waste practices in these countries renders them vulnerable to exploitation by developed nations employing strict regulations within their own domestic confines.[10]

In 2017, Nigeria produced 290 000 tonnes of e-waste, increasing by 170% against 2009 volumes. Yet Nigeria receives most of its EEE from abroad. Every month, 500 containers, each carrying an approximated 500 000 used computers in addition to other electrical equipment, leave Europe, the United States and Asia, bound for the port of Lagos.[11] Casting an already-dubious practice into further disrepute, such imports often contain hidden or falsely declared e-waste – for example, between

2015 and 2016, 69% of Nigeria's incoming EEE constituted undeclared electronic equipment smuggled in vehicles legally imported from Europe.[12] Another study found that 25% of incoming EEE was dead on arrival, and subsequently redirected straight to dumps and dismantling sites.[13] Similarly, Accra's Agbogbloshie, a slum and former wetland area, has been transformed into the world's largest e-waste dumpsite[14] and the archetype of the techno-apocalyptic worst-case scenario. Exemplifying the bitter end of the product value chain, it is hardly surprising that is has been dubbed a modern-day Sodom. The vast volumes of e-waste entering the country are often falsely declared as second-hand EEE – in 2016 alone, Ghana amassed 39 000 tonnes of e-waste. Each month, the port of Accra receives between 600 and 1 000 containers of EEE, only a fraction of which are functional.[15] In both countries, electronic imports of no economic value are dumped or burned, releasing chemical toxins and heavy metal pollutants that contaminate the air, water and soil.[16] An estimated 10 000 informal labourers working in the informal e-waste recycling sector in each country are consequently directly exposed to hazardous chemicals, incurring respiratory and dermatological problems, chronic headaches and lowered life expectancies[17],[18] – an electronic epidemic in the literal sense. It's a devil's trade-off – wherein livelihoods are gained at dire personal cost.

Electronic imports of no economic value are dumped or burned, releasing chemical toxins and heavy metal pollutants that contaminate the air, water and soil

In conjunction with the illegal transboundary movements of e-waste, there currently exists a significant demand for EEE in developing nations – individual EEE demands are on the rise across Africa due to increases in disposable incomes; yet the purchasing power parity in the region directs this demand towards cheaper, second-hand devices. Coupled with the region's low reparation costs, this demand has spawned a burgeoning re-use market in poor developing nations across Africa,[19] which in turn contributes to greater volumes of domestic e-waste owing to the shortened lifespan of outdated devices. One needs also to consider the extent to which domestic consumption in Africa contributes to its digital dumps. A study investigating the scope of West Africa's impact on its e-waste woes found that up to 85% of the e-waste in the region originated from within the countries themselves.[20] Given the fact that significant volumes of e-waste imports are either wrongly classified or undeclared, and that the often-defunct state of working devices provides fleeting functionality, attributing this level of responsibility to West Africa gravely distorts the nature of the dynamics at play.

The Economics of E-Waste: Exporting Externalities and Toxic Trade-Offs

It becomes apparent that globalisation has engendered a system that continues to crush the vulnerable poor. The narrative of the global north imposing its self-interest over that of the global south provides an age-old, if not hackneyed, surface-level explanation of events. Bearing in mind the simple truth that *money matters* in a global climate dominated by capitalism, it would prove useful to unpack the economics underpinning the current e-waste calamity.

A combination of growing demand for cheaper products and cost-cutting measures in competitive markets has yielded a blatant market externality – the failure to appropriately budget for the mounting costs incumbent with proper e-waste disposal. The cost of safe e-waste disposal is substantial – while it costs around US$20 to safely dismantle and dispose of a single computer in the United States, unsafe disposal of the same item, via acid baths or open-air burning, can be achieved for around US$2 in the developing world[21]. Overseas shipment costs less

than employing sound recycling domestically. Furthermore, selling defunct products to 'urban mining' companies for [unsound] disassembling and recycling enables exporting agents to present farcical commitments to pro-poor greening endeavours through their supposed 'outsourcing' of e-waste recycling. With the sirenic allure of peak profit speaking to an innately human sense of greed, the cost savings alone are enough to quash any ethical misgivings, prompting decisions to export the negative externalities (attendant with improper disposal) to poverty-stricken developing countries. In short, economic agents in the developed world derive benefits from capitalising on rapid technological turnovers, yet do not bear the full associated costs (i.e. social, environmental and financial) attendant with product disposal. While electrical commodity consumption is a global process, the full spectrum of attendant impacts is disproportionately distributed, with the developing world hit hardest – in conjunction with saving a pretty penny, because exporting countries are not directly impacted by the social and ecological impacts of e-waste exportation, they are not incentivised to internalise their waste-generating externalities. It becomes clear that Africa's current e-waste debacle is, simply put, a symptom of market failure.

Economic agents in the developed world derive benefits from capitalising on rapid technological turnovers, yet do not bear the full associated costs

Yet there are economic incentives driving the import of e-waste in developed nations too. This is because e-waste contains precious metals – for example, it is estimated that 1 tonne of cellphone circuitry contains more than 30 times more gold than is present in the same tonnage of mineral ore (at 150g per tonne compared to 5g per tonne)[22], and that up to 7% of the world's gold is likely contained in e-waste devices.[23] Also contained within one tonne of cellphone e-waste are 3kg of silver and 100kg of copper, amongst smaller quantities of other recyclable metals.[24] It has been disclosed that 14 metals present in electronic products are currently in critical supply,[25] presenting their extraction from discarded devices as both a business opportunity and way of extending the finity of raw materials. In addition to reducing the waste of recyclable precious metals extracted from discarded electronics, it is also argued that the risks incurred by the urban mining of e-waste are less than those suffered by traditional mining.[26] Moreover, it has also been demonstrated that the financial cost of recovering valuable metals from e-waste makes the urban mining sector more lucrative than virgin mining.[27] Notwithstanding the costs to social and environmental well-being, informal urban mining, therefore, presents itself as an attractive alternative to the traditional mining sector, and has led countries like Nigeria and Ghana to pay abroad manufacturers for their e-waste. It is a sordid rendition of a banal cliché – 'One man's trash is another man's [toxic] treasure'.

Economic Exit Strategies: Utilising Market-Based Instruments to Disincentivise Africa's E-Waste Dumping

In countries like Nigeria and Ghana, a deficit in formal sector employment opportunities, in conjunction with burgeoning urban population numbers, have resulted in e-waste scavenging becoming a key livelihood strategy despite its associated risks. It is, therefore, important to simultaneously consider the challenges emerging from contemporary e-waste flows, as well as the opportunities it presents. Given the unrelenting prevalence of consumerist culture in the digital age, the cost-cutting proclivities of economic agents, and the need for revenue streams amongst informal workers in regions subject to abject poverty, the African e-waste epidemic is set to continue, en route to the region's digital demise. Understanding the economic factors driving

Africa's digital dystopia, however, may provide invaluable insights into ways in which economics could be harnessed to thwart this trajectory by maximising the profitability of e-waste recycling and compelling agents to internalise their negative externalities. The question then arises: in a world where money matters, can we make money talk in favour of sustainability?

Pigouvian Payouts: Employing Game Theory Rationale to Incentivise Recycling

Drawing from economic game theory, in order to mitigate the generation of negative externalities, one should strive to create solutions that are Pareto-optimal (referring to an outcome in which further reallocation of resources benefits one party at the expense of another). A transboundary policy of Pigouvian taxation, whereby economic activities generating socially or environmentally harmful externalities are taxed according to the value of the marginal losses sustained by the victims of the externalities, could be levied on e-waste exporters, thereby driving up the relative cost of shipping noxious products abroad and making sound electronic recycling the more financially lucrative option. This tax would additionally increase production costs and electronic commodity prices, thereby lowering market demand amongst consumers seeking to avoid the added cost stemming from a pollution tax, creating further incentive for e-waste reduction. This would effectively decrease the negative externality (i.e. environmental pollution and incumbent health risks) associated with the electronics market.

In a world where money matters, can we make money talk in favour of sustainability?

Tackling the Tragedy of the Commons

Electronic dumping grounds are subject to the classic notion of the 'tragedy of the commons', a phenomenon central to sustainability describing a situation in which individuals overexploit shared finite resources in order to maximise short-term personal gain, regardless of the long-term ramifications.[28] Aligning with this phenomenon is the concomitant market failure of free riding – because e-waste dumpsites are not subject to regulations, users accrue no additional costs or accountability when utilising this public resource. Public resources refer to those which are non-excludable (i.e. individuals cannot be barred from consumption of that resource) and non-rivalrous (i.e. one individual's consumption of the resource does not restrict the consumption of others). E-waste dumping grounds, in fact, cannot truly be deemed non-rivalrous owing to them being finite – yet enduring societal failure to recognise the finity of the resource, which results in it being exploited as non-excludable and non-rival, yields the externality of uncompensated social and environmental costs.

Electronic dumping grounds are subject to the classic notion of the 'tragedy of the commons'

Economists attribute this tragic market failure to the absence of well-defined property rights governing e-waste dumpsites. If the resource (in this case, land) were subject to clearly defined property rights, it would be a much simpler process to broker agreements amongst landowners in favour of long-term sustainability.[29] For example, landowners would be able to mandate payment, to the value of costs incurred, for e-waste disposal – in economic terms, the compensated landowner would be incentivising the land users to optimise the resource and internalise the negative externalities associated with digital dumping. Forcing actors to internalise their individual costs furthermore prevents the sharing of costs stemming from public resource over-exploitation, whilst compelling agents to gain an understanding of the total costs associated with improper e-waste disposal.

The Potential for PES: Profiting off Environmental Protection

Assigning enforceable property rights to electronic dumpsites would have the additional benefit of enabling landowners to participate in Payment for Ecosystem Services (PES) schemes. PES initiatives are a market-based instrument that offers landowners financial incentives for managing their land in a way that ensures the continued provision of ecosystem services (a term referring to the vital services humans derive from natural capital, such as water purification, carbon sequestration and flood prevention). The export of e-waste to poor developing nations is problematic due to the fact that these regions often lack adequate infrastructure to facilitate proactive waste management – ensuant practices catalyse a virulent defilement of ever-dwindling natural capital and the critical ecosystem services this provides. In developing nations, recycling operations typically include the burning of non-biodegradable plastic covers, or their submergence in acid, to enable the recovery of gold and other precious metals and minerals, as well as the burning of circuitry for the extraction of solder.[30] Acid baths are subsequently dumped into surface water, tainting fresh-water ecosystems, whilst e-waste burning perniciously alters the atmospheric chemical composition.

The export of e-waste to poor developing nations is problematic due to the fact that these regions often lack adequate infrastructure to facilitate proactive waste management

Command and control policies, involving the establishment of legal norms together with legal penalties for noncompliance, have traditionally been enforced to deter economic processes driving environmental degradation. Such mechanisms, while effective in deterring the generation of negative externalities from distinct point sources (e.g. industrial plants), are relatively ineffectual in eliciting regulatory response from non-point sources (e.g. multiple landowners).[31] Economic incentive-based mechanisms like PES are, therefore, being increasingly proposed to safeguard environmental capital whilst presenting landowners with a financially lucrative alternative land-use option by facilitating a transition from an ecologically erosive economy to one of stewardship.[32] Furthermore, PES implementation, by engaging previously non-participant actors in conservation efforts, inadvertently generates awareness about the value of natural capital whilst increasing compliance with global multilateral environmental agreements.

Circling Back to the Future: Pioneering a Circular Economy with Extended Producer Responsibility

It is undeniable that the current 'take, make and dispose'[33] model characterising today's toxic trash trade negatively impacts environmental and societal health. According to the World Health Organisation[34], this represents an historical inflection point for both global business and policymakers, where the prioritisation of dematerialisation and closed-loop systems (i.e. a system that deters overreliance on primary resources for production), and innovating waste out of the production cycle by mandating durable design and sound recycling, presents a transitory (and therefore, pressing) opportunity to stave off worst case scenarios – ultimately, this necessitates the supplanting of the prevailing linear economic system with a regenerative circular economy.

Transitioning to a circular economy encompasses the following:[35]

- *Design*: durability, reuse and recyclability should influence the design of products.
- *Buy-back Systems*: the provision of buy-back systems by producers incentivises consumers to reduce their e-waste.
- *Recycling and Recapture*: businesses and governments need to prioritise closed-loop production cycles in which old electronic components are incorporated into new products.
- *Urban Mining*: companies need to invest in the sound extraction of metals from e-waste.

Developing nations need to develop unambiguous and enforceable e-waste legislation aligning with global protocols of environmental and societal health and safety. This presents an opportunity for economic growth in developing nations through decent job creation in a formalised sector.

- *Reverse Supply Chain Logistics*: a reverse supply chain model needs to ensure that recaptured materials do not deviate into the informal sector.

Within the traditional linear economy, the practice of exporting e-waste (or shifting the costs of disposal) and the attendant externalities to developing nations has become central to maximising producer profits. The policy principle of Extended Producer Responsibility (EPR) presents a mechanism of incentivising producers to improve the environmental design of their products, as well as the environmental impact of supplying these products.[36] EPR policies require producers to bear total responsibility for all stages of the product lifecycle, including end-of-life (EoL) management. Producers are mandated to either establish protocols for consumers to facilitate the disposal of EoL products through normal waste streams or take back their used products to effect proper disposal procedures themselves. Placing the onus of disposal on producers ensures that they factor its cost into the product value, thereby internalising the cost of disposal.

Concluding Remarks: Making Waste Work for Africa

Within the context of today's globalised e-waste sector, transitions towards a circular economic model for electronics is predicted to yield significant economic benefits – under this model, consumer costs are projected to decline by 7% by 2030 and 14% by 2040.[37] Given the concurrent dilemmas of mounting e-waste streams, rising resource scarcity, and the price instability of various metals and minerals required for electronics production, there is a growing economic appeal backing the transition. The concurrent implementation of market-based mechanisms like Pigouvian tax, PES, and the institution of land rights to financially incentivise responsible waste handling could prove useful in expediting the shift. Furthermore urban mining is vastly more economically viable and less energy intensive than traditional mining – if governed under the principles of EPR, the sector presents a golden opportunity to reboot the globalised e-waste market by incentivising producers to invest in developing the infrastructural capacity for sound recycling, compliant with global environmental and societal health and safety regulations, in developing nations like Nigeria and Ghana, generating formal sector employment opportunities and just transitions to environmental sustainability. Africa's hopes for sustainable economic growth, with respect to the omnipresent e-waste trade, need not yet be discarded in the dumps.

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