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DANGEROUS DONATIONS:
DISCARDED ELECTRONICS IN ACCRA, GHANA

A Thesis in
Geography

by

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Abstract

In this thesis, I use the example of Accra, Ghana to examine the fate of computer equipment donated from the global North to the South. These donations, though tangibly beneficial, may have unintended and unanticipated consequences that are unknown to donor organizations in the North. When the computers inevitably fail, they must be discarded. Yet, countries of the South lack adequate facilities to safely reprocess the toxic materials contained in this equipment. As a result, some communities are disproportionately exposed to lead, ground water pollution, and other toxics. I show how the communities affected are not chosen at random and can best be understood using nascent theoretical advances in environmental justice. These advances stress the need for a conception of environmental justice that incorporates not just maldistribution, but lack of recognition of affected parties as possessing equal human rights, and consequent lack of access to environmental decision-making. I argue that political ecology provides a valuable framework for examining environmental injustice, but can also benefit from the incorporation of these theories of environmental justice.

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Abbreviations Used

AMA – Accra Metropolitan Assembly

BAN – Basel Action Network

CEPS – Customs, Excise, and Preventive Service of Ghana

CRT – Cathode Ray Tube

EPA – Environmental Protection Agency Ghana

PWB – Printed Wiring Board

StEP – Solving the E-waste Problem (United Nations Program)

WMD – Waste Management Division of the Accra Metropolitan Assembly

WCE – World Computer Exchange

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We are just a child
We are just a child
We are wide awake
But our legs are shaky
We're unaware
We're hyperactive
We stare into space with grins on our faces
So give us what we're asking for
'Cause either way, we're gonna take it
Our power doesn't run on nothing
We need the land you're standing on so
Let's go!
Move it!
We are old as hell
We are old and tell the children
When to kill and when to sit still
Everyone doing what we say
Till our dying day, till our breath is empty
So give us what we're asking for
'Cause either way we're gonna take it
Our power doesn't run on nothing
We need the land you're standing on so
Let's go!
Move it!
– The Thermals, "Power doesn't run on nothing"



“At ten o'clock he came away, choosing a circuitous route homeward to pass the gates of the college whose head had just sent him the note.

“The gates were shut, and, by an impulse, he took from his pocket the lump of chalk which as a workman he usually carried there, and wrote along the wall.

'I HAVE UNDERSTANDING AS WELL
AS YOU; I AM NOT INFERIOR TO YOU:
YEA, WHO KNOWETH NOT SUCH
THINGS AS THESE?' – Job xii. 3.”

– Thomas Hardy, “Jude the Obscure”

Chapter 1: Introduction

Since the widespread adoption of the computer and particularly Internet technologies in the global North, an increasing concern with closing the “digital divide” between the global South and North has also developed. As a consequence, charitable and aid organizations are attempting to close this technology gap, in part, with donated computer equipment. These donations, though tangibly beneficial, may have unintended and unanticipated consequences, such as exposing people to lead, causing ground water pollution, or workplace hazards. Recipient countries usually lack adequate facilities to safely reprocess the toxic materials contained in this equipment. When the computers inevitably fail, they are discarded – typically in or near poor communities. These communities are not chosen at random; their excess burden of toxic waste is closely intertwined with processes of social devaluation and denial of political rights. These processes are often opaque to donor organizations operating in the global North, who may unknowingly contribute to an environmental injustice. It is this injustice that I study in this thesis.

I came to this research topic through my own experiences volunteering in the context of the “digital divide.” I worked for many years in the computer industry and, when I could, I used my skills to do training and installations of computer equipment in the global South, at universities, schools, and community centers. I had personally given little thought to what happens to the equipment I installed until I read a newspaper article on a report by the Basel Action Network (Puckett, Westervelt, Gutierrez, & Takamiya, 2005). This report documented the problems of e-waste, as discarded computer equipment is popularly known, in Nigeria, where I had worked. As I explored further, I found that much of the discussion on e-waste emphasized either the technical aspects of manufacturing and distribution or the final disposal. The questions that occurred to

me, as a Geographer, were: why does e-waste end up in a particular place and not some other place and have I contributed to this problem in my own charitable work?

Geographers are trained to be aware of scale; hence, the multi-scalar nature of these questions seemed obvious. To understand these questions would require a broad appreciation of the context in which social processes operate. I argue that political ecology provides the appropriate conceptual framework for studying these multi-scalar processes and how they generate environmental injustices. Political ecologists work to describe the multi-scalar processes that shape human-environment interactions in their broader historical, political, and economic contexts.

In traditional political ecological approaches, the emphases are often on the role of transnational actors, such as large corporations or the World Bank, and how the global flows of capital they support ultimately lead to the marginalization of the least powerful. More recently, political ecologists have also begun to explain environmental outcomes as products of unequal power relations (Bryant & Bailey, 1997). However, I argue that political ecologists would benefit from the inclusion of recent theoretical advances in understanding environmental injustice. These advances, which build on liberal, Rawlsian notions of justice, emphasize the need for a broader view of environmental injustice that incorporates not just maldistribution (including uneven distribution of power), but also the lack of recognition of affected parties as possessing of human rights, and the lack of participation in environmental decision-making (Schlosberg, 2007). At first blush, this liberal, rights-based theory may seem to conflict with much of the political ecology tradition, which often comes from a Marxist political economy perspective, which has sometimes been accused of being over-deterministic or structurally rigid. I will argue that this new environmental justice theory contributes an important perspective that can add flexibility and insights to the political ecology tradition without requiring an abandonment of what came before. In this research, I will show that this theory is in operation at multiple scales and provides an insight that is lacking in political ecology.

1.1. Overview of the Research

At the local scale, it can be assumed that the likelihood of an e-waste problem would be proportional to demand for computer equipment and inversely proportional to waste management capacity. I focused my research on Accra, Ghana, because it has both a high demand for computer equipment and inadequate solid waste management. I designed the research questions to address the multi-scalar nature of the problem, to see how the social, economic, and political processes played out in one particular location. I begin with an examination of charitable organizations operating in the global North and where they acquire and how and to whom they distribute their donated equipment. Then I move to the recipient organizations and examine how they manage and dispose of the equipment they receive. After disposal, I investigate what happens to the computers and, more importantly, who handles the disposal and what are the social, political, and economic aspects of that disposal. Finally, the question arises as to who is most affected by the disposal, and what capacity do those people have for controlling or preventing the negative effects of that disposal.

The data acquired for this study comes chiefly from interviews conducted with charitable organizations and from interviews conducted in Accra. These are supplemented with focus group discussions and a community mapping exercise. The Customs, Excise, and Preventive Service of Ghana (CEPS) provided a database detailing shipments of electronics and scrap metals. Finally, the World Computer Exchange (WCE), a Boston-based organization focusing on collecting computer equipment and distributing it to other organizations, publishes on its website all of its official documents, including implementation plans from partner organizations. I examined all 24 of the plans that come from organizations in Ghana.

This thesis is divided into six chapters. The first is this introduction, the second contains a review of the relevant literature, and the third chapter describes the research setting, the data collected, and the methods used to analyze the data. Chapter four

presents the results of the research and chapter five the discussion. The final chapter concludes the thesis.

Chapter 2: Literature Review

2.1. Introduction

My research focuses on the scalar production of a particular environmental injustice, in a particular location – the inequitable distribution of risks from electronic waste in Accra, Ghana. I use political ecology as a framework and show how this framework can be usefully combined with recent theories of environmental justice to gain a better understanding of not only my chosen environmental injustice, but of environmental injustice generally.

This section contains a review of the relevant literature on electronic waste, political ecology, and environmental justice. It is divided into several sub-sections. The first sub-section discusses the history of electronic waste and the increasing movement of this waste into the global South, including in particular that which comes as charitable donations. The second sub-section contains a brief background on political ecology. The third section focuses on theoretical issues of environmental justice and how these theories can be combined with political ecology to achieve a greater understanding of environmental justice. As background to understanding e-waste in Accra, the last section discusses political ecology work in waste management. Finally, I provide an overview of waste management in Ghana and Accra.

2.2. E-waste and the South

2.2.1. Transboundary Movement of E-waste

There is no universal definition of e-waste, but it is generally considered to consist of “various types of waste containing mainly electronic components. Common e-wastes

include: Personal Computers (PC), televisions, telephones, cell phones, electronic toys, air conditioners, hi-fi sets and the like” (UNEP, 2004, p. 5). Although exact numbers are not available (Jain & Sareen, 2004; Williams, 2004), e-waste makes up an increasing part of waste flows from the North to the South (Matthews & Matthews, 2003; UNEP, 2004). The continued expansion of computer and electronics markets fuels this growth. The financial depreciation cycle of computer equipment helps to ensure that old material will regularly and frequently be replaced with newer equipment, which in turn requires the disposal or recycling of retired equipment.

E-waste contains numerous toxic heavy metals and organic compounds, export of which is banned under the United Nation’s Basel Convention¹ (ratified 1989, effective 1992). The banned e-waste components include some batteries (such as nickel-cadmium based) and accumulators, mercury switches, leaded glass from cathode ray tubes (CRTs), PCB-containing capacitors or any component contaminated with lead, mercury, or cadmium, among other compounds. Printed circuit boards are exempt, unless they are contaminated as above (Kojima, 2005).

The United States Environmental Protection Agency estimates that 70 percent of the heavy metals in the United States’ solid waste stream originate in e-waste (Environmental Protection Agency, 2004). Lead, in particular, causes much concern in electronics disposal and export, particularly that from cathode ray tubes (Socolof, Overly, Kincaid, & Geibig, 2001; Townsend, Musson, Jang, & Chung, 1999). Levels that exceed safety limits of lead, cadmium, copper, zinc, and antimony have been documented in the ash of burned e-waste dumps (Allsopp, Santillo, & Johnston, 2006), and dust collected from roads near e-waste recycling facilities have been shown to have levels of lead 330 times higher than roads several kilometers away (Leung, Duzgoren-Aydin, Cheung, & Wong, 2008).

¹ As of October 2007, most countries of the South and North have ratified the Basel Convention, with the notable exception of the United States (United Nations, 2007).

E-waste is not entirely toxic material; it also contains valuable recyclable material, particularly steel, aluminum, and copper. A table showing many of the materials used in computer manufacturing and their potential for recycling is included in Appendix C. At the end of a computer's lifespan, these raw materials are worth only one to five percent of the computer's original cost, with 70% of that value in the metals (Matthews & Matthews, 2003). This low value means that, in the United States, e-waste recyclers must demand direct payment from the consumer or the government to make a profit. Notably, one corporation, the federally-owned Federal Prison Industries (a.k.a. UNICOR), has been quite successful in their electronics recycling business; they are able to charge one-quarter of what their competition charges per pound – success enabled through the use of very cheap prison labor (Grossman, 2006).

In short, the economics of e-waste recycling are such that there is little financial incentive in the North to recycle e-waste. This has led to calls for “Extended Producer Responsibility” – essentially a demand for manufacturers to take back machines at the end of their life, functionally building the cost of disposal into the sale price. However, take back programs are not yet widespread and are only now beginning to be studied for efficacy (Tojo, 2006). The reality is, unfortunately, that much electronic waste is exported.

Indeed, Lawrence Summers, then Chief Economist of the World Bank, was widely vilified for discussing the economic logic of toxic waste export in a leaked memo, famously saying, “I think the economic logic behind dumping a load of toxic waste in the lowest-wage country is impeccable and we should face up to that” (“Let them eat pollution,” 1992). The basis of much of the vilification was the assumption of Summer's inhumanity, but that focus largely ignored the statement's factual accuracy. There is no strong financial incentive to recycle electronic waste in the wealthy countries of the global North.

In the US, the trade imbalance with China and India creates a glut of return shipping capacity. For instance at the Port of Los Angeles, 59% of its Twenty-Foot Equivalent containers left the port empty in fiscal year 2007 (Port of Los Angeles, 2007b); nearly half of the Port's trade was with China (Port of Los Angeles, 2007a). Because shippers would rather carry anything than deadhead, the shipping of e-waste out of the US to China and India remains very inexpensive and lower labor costs in these countries allow recyclers to still turn a profit, despite the cost of shipping (Puckett, 2006; Yoshida, 2005).

Although the export of e-waste should fall under the Basel Convention, the convention has been largely ineffective at stopping the flow of toxics from the North to the South (Kojima, 2005; Puckett et al., 2002; Puckett et al., 2005). Problems include insufficient enforcement by both importing and exporting countries, demand for resources in developing economies, and fraudulent declaration of exports (Heller, 2007; Kojima, 2005).

Tacitly admitting this failure, the United Nations created the Solving the E-waste Problem (StEP) initiative in March 2007 to study and address the global e-waste problem. Past works by the leading researchers at StEP indicate that the initiative will likely focus on improving efficiency of production and transportation, and reducing demand for new equipment by extending the lifetime of electronics through resale and reuse (Cole, 2003; Kuehr, 2003; Williams & Kuehr, 2003). While improving efficiency and lifespan is important, it is an incomplete solution. StEP's focus on greener production in industrialized nations does little to address the effects of the export trade, especially in light of the hundreds of millions of computers already produced.

Even if the ban were effective, if equipment which would otherwise not be exportable is sent with the intention of re-use, the Basel Convention does not apply (Kojima, Terazono, Yoshida, Terao, & Yamashita, 2005). Because the cost of new computers is high and desire for computer technology in the South is also high, demand

for used computers in the South has been increasing, further inviting the North to export its discarded equipment to the South (UK Trade and Investment, 2007). Furthermore, StEP's focus on production completely neglects those who are most directly affected by the often inadequate or outright dangerous disposal practices used with e-waste in the South: the most marginalized members of society. In this research I seek to understand how e-waste effects these people and their communities.

The existence of e-waste dumps in communities of the South came to attention through two key publications created jointly by activist organizations, including the Basel Action Network (BAN), the Silicon Valley Toxics Coalition (SVTC), and Toxics Link India. The first of these publications, "Exporting Harm" (Puckett et al., 2002), focused on the e-waste problem in Asia, particularly the Guiyu region of China, and the cities of Karachi, Pakistan and New Dehli, India. The report emphasized the exposure to dangerous compounds² by people employed in the informal (but nonetheless large) e-waste recycling industries in these areas. Recycling practices documented include the "cracking" of monitors to remove copper, exposing the lead inside. Other processes documented include acid baths to remove precious metals from printed circuit boards, and chipping of plastics for recycling.

In the follow-up report, "The Digital Dump," Puckett et al. (2005) documented the import of e-waste to Nigeria. While the report described little of the highly toxic, large-scale recycling operations that occur in China and India, there is still cause for concern. The authors report that some 500 shipping containers of e-waste come into the port at Lagos each month. They estimate 45% of this material came from the United States, 45% from Europe, and 10% from other locations. Some 25-75% of this material was non-functional and immediately discarded in formal and informal dumpsites,

² Compounds of concern include lead, which causes developmental difficulties in children and teenagers, and severe nervous system damage in adults and children; cadmium, inhalation of which causes kidney and bone damage; mercury, a toxic heavy metal that causes nervous system damage; and PCBs, carcinogenic compounds also implicated in immune system, nervous system, and reproductive system damage.

though some harvesting of copper was reported. These dumpsites were frequently burned, exposing nearby communities to toxic compounds in the smoke, as well as potentially contaminating groundwater. The report did not examine the communities near these dumps.

Indeed, no comprehensive study of the local health effects of e-waste dumps has been performed (Allsopp et al., 2006), nor has anyone done an analysis of the socio-economic and political processes that lead to dumping in particular places. The only significant academic contribution to social concerns surrounding e-waste is that of Pellow (2006). In that work, he discusses the global network of e-waste activist organizations that created these reports, but does not address the processes by which e-waste moves from the North to the South. The volume he co-edited (Smith, Sonnenfeld, & Pellow, 2006) also focuses on production issues, with a particular emphasis on health and the attempts of those working in the production of computers to create labor organizations. The only chapter in that volume that deals with actual waste concerns is by the lead author of the aforementioned BAN reports (Puckett, 2006) and largely contains a re-hash of the material in those reports. Somehow, researchers have neglected the social and economic processes of e-waste at the local level and how these processes relate to environmental justice. I attempt to fill that gap with this research.

While these large e-waste dumps garner much attention, no work addresses the smaller, but also hazardous problems with e-waste in other countries. There is no reason to think that Nigeria is unique in being largely “off the radar” as dumping ground for e-waste. I chose to focus on Ghana because it is a relatively small country, yet seen as a good market for used computers from Britain (UK Trade and Investment). This demand is reflected in (and fueled by) the fact that Ghana has one of the highest Internet access rates in sub-Saharan Africa (Wallsten, 2005). Combined with the fact that waste management in Accra is inadequate (discussed in greater detail later), it is reasonable to assume that Accra would have an e-waste problem.

2.2.2. Charitable Donations of Computer Equipment

In this thesis, I emphasize the role played by organizations that send computers to the South as charitable donations. I do not intend to document intentional subversions of the toxics ban, but to highlight the importance of critical examination of all aspects of the e-waste trade. To do this, I examine the broader issue of e-waste in the developing world; donated computers cannot be meaningfully separated from the general e-waste stream, as I show later.

Because the gap in Information Technology capabilities between the rich and the poor (a.k.a. “the digital divide”) is a major concern for aid and development organizations (Drori & Jang, 2003), it can be assumed that this flow of donated material will only increase, particularly to the poorest countries. However, little work addresses this aspect of e-waste flows. A brief mention of charitable donations as a *potential* problem was made by Pellow (2007, p. 200), and Toxics Link (2003) discussed the general problem of import of computers for e-waste, and the short lifespan thereof. Although no research has been done on the total volume of this material (Toxics Link, 2003), and while it likely makes up a relatively small portion of the total e-waste flow, it would be a mistake to dismiss it as insignificant.

For example, the UK-based organization Computer Aid International claims to be the largest donor of computers to the developing world, with over 75,000 computers donated since 1998, primarily to South Africa and Kenya. Computer Aid hopes to achieve 100,000 total computer shipments by October 2007. Though their annual report states that, “any equipment that cannot be reused is recycled in state-of-the-art facilities with zero percent going to landfill” (Computer Aid International, 2006, p. 4), this applies only to the United Kingdom; no mention is made of provisions for disposal in the recipient country.

As of October 2006, the Boston-based organization World Computer Exchange (WCE) had shipped 20,774 computers to 34 different countries. Unlike the previous

organization, WCE does have a nascent e-waste initiative, though it focuses primarily on education in proper handling of e-waste (World Computer Exchange, 2006a, 2006b). It overlooks the lack of proper facilities and fails to recognize an affected community need for a voice in environmental decision-making.

WCE's work in Ghana is analyzed later in this thesis. Also in Ghana, the Seattle-based Global Technology Academy recently donated over 500 computers to the Ghana Ministry of Education. The Ministry of Education plays an important role in charitable e-waste in Ghana – a role that I also discuss later in this thesis. Because I argue that the e-waste in Accra is managed in a manner that results in environmental injustice, it is crucial to understand what I mean by environmental injustice and how to study it when it occurs. I will argue that political ecology supplies a particularly valuable framework for understanding environmental injustice, provided researchers can avoid some of its inherited rigidity.

2.3. Political Ecology

Political ecology concerns itself with placing the processes that shape human-environment interactions in their broader historical, political, and economic contexts (Bryant & Bailey, 1997). Definitions vary, but it is frequently described as a melding of the “concerns of ecology and a broadly defined political economy” (P. Blaikie & Brookfield, 1987, p. 17), particularly Marxist political economy, and cultural ecology. Peterson (2000, p. 323) defines political ecology as “an approach that combines the concerns of ecology and political economy to represent an ever-changing dynamic tension between ecological and human change, and between diverse groups within society at scales from the local individual to the Earth as a whole.” The ways that political ecologists actually work varies as well.

In an echo of political ecology's Marxist roots, Robbins (2004) argues that local systems of production undergo a transformation into over-exploitation when they are

introduced into the global market. This particularly affects marginalized populations. In his argument, as people are drawn into the capitalist system, the capital inevitably flows in a chain from the producer to the investor and the land-holder, ultimately leading to marginalization and degradation of the environment as modes of production are transformed from supporting local sustenance to providing a global commodity.

Political ecologists make use of multiple methods as they attempt to characterize these dynamics, including political-economic analysis, historical analysis, ethnography, discourse analysis, ethnographic methodologies, and in particular, multi-scalar analysis of power relations (Neumann, 2005). These power relations shape environmental outcomes and cause political marginalization, and these processes of ecological and political marginalization are closely interlinked and self-reinforcing (Bryant, 1998; Neumann, 2005).

For example, in his pioneering political ecology work, Blaikie (1985) uses neo-Marxist theory to show how land degradation is a result of specific human practices, and these are shaped through power relations. He also shows how marginalized peoples are pushed to marginalized lands, leaving them more vulnerable to “natural” disasters. While Blaikie focused on agricultural land, it is not much of a stretch to see that marginalized lands and people would also include those that were inequitably affected by toxic waste, and indeed this can be seen in the environmental justice movement.

2.4. Environmental Justice in Political Ecology

Emerging from the civil rights movement in the United States, the environmental justice movement has typically focused on the disproportionate location of toxic waste creating and disposing facilities near minority communities – a reality that is very well documented (Bullard, 2000; Bullard, Mohai, Saha, & Wright, 2007; Daniels & Friedman, 1999). However, as the topic has been more heavily debated, an increasing dissatisfaction with this purely descriptive approach to environmental injustice has arisen. For instance,

Ruiters (2002) asserts that “a deeper approach to environmental justice [...] requires a focus on the *production* and *prevention* of injustices” (p. 112, emphasis in original).

Pellow (2000) also criticizes this emphasis on distribution and takes up the theoretical challenge. He proposes a theory of environmental inequality (his preferred term) in which environmental inequalities form not as the simple result of perpetrators victimizing a particular group but,

“[...] when different stakeholders struggle for access to scarce resources within the political economy, and the benefits and costs of those resources become distributed unevenly. That is, those stakeholders who are unable to effectively mobilize resources are most likely to suffer from environmental inequality. Conversely, those stakeholders with the greatest access to scarce resources are able to deprive other stakeholders from that same access.” (p. 589)

He further argues that understanding these struggles will require a shift from site-specific examinations of environmental injustice to a life cycle analysis approach, in which hazards materials production is understood from cradle to grave. In later works (Pellow, 2007), he expands the argument to explicitly include racism as a factor in the creation of environmental injustice. However, he also criticizes race theorists for not taking into account political economic concerns, while simultaneously criticizing political economists in the Marxist vein for not taking enough account of the dynamics of race and culture in the production of injustice.

Similarly critical of the distributional focus, Swyngedouw and Heynen (2003) insist that only a political ecology based in a Marxist theoretical perspective can understand the generation of environmental injustice. In this perspective, environmental injustices are the byproduct of uneven social relations and these uneven social relations are “integral to the functioning of a capitalist political-economic system” (p. 910). Pellow (2000) would, perhaps, call these uneven relationships stakeholder struggles, though in contrast to the Marxist perspective, he does not argue that they are inevitably built into

the political-economic system, but are simply the byproduct of continual conflict and renegotiation of social relations.

I empathize with Pellow's (2007) later argument that race is under-considered in the Marxist tradition, but I also take issue with his argument of racism as the main driving force in environmental injustice. That is not to say that race is unimportant, but that a sole emphasis on racial discrimination is not sufficient. Discrimination can occur for a number of reasons and those types of discrimination often follow particular patterns. For instance, Pellow writes, "this racist logic, which give ethnic minorities an 'animalistic' quality justified the concentration of people of color in jobs and residential spaces that are particularly dirty or hazardous" (Pellow, 2007, p. 39). However, this type of linguistic de-humanization appears to be a major feature of all violent human conflict. Jews in Nazi-era Germany were referred to as "parasites" among many other epithets; extremist Hutus publicly referred to Tutsis as "cockroaches" in the lead up to the genocide in Rwanda (Waller, 2002). Similar behaviors are well documented in other cases of genocide (Power, 2002). In the case of the Rwandan genocide, it is difficult to make an argument that there was even an ethnic distinction between Hutus and Tutsis. As I will argue later, it is the "mere" denial of equal human rights, regardless of the motivation, that contributes to cases of environmental injustice.

In these cases, it is perhaps better to focus not on questions of race, but to see race itself as a by-product of an in-group/out-group mentality that permeates human societies with racism being one negative manifestation of this mentality. In his book on the psychology of mass murder, Waller (2002) calls this innate tendency "our ancestral shadow" and cites research that shows that even arbitrary and artificial classifications of people can elicit ethnocentric responses in research subjects. My purpose here is not to analyze this literature, as interesting as it is, but to point out that any theory of environmental injustice needs to incorporate a deeper understanding of group conflict than one merely based on race.

By focusing solely on race, we also lose sight of the local scale – the actual venue of environmental injustice. While Pellow (2007) makes an important contribution to our understanding of the combined racial and economic nature of environmental injustice, his theory is still incapable of explaining particular local manifestations of injustice. There may be many minority communities in a region, yet only one of them can be chosen as the site for an incinerator or a landfill. We should be asking ourselves “why this minority community and not that one?” It is that question of scale, in particular, that political ecologists attempt to understand. However, political ecology has itself faced some criticism as being over-deterministic.

The strongly structural Marxist perspective, such as that of Swyngedouw and Heynen (2003), is increasingly criticized; a trend away from strictly Marxist theory was noted years ago (Bryant, 1998). Vayda and Walters (1999) were outspoken critics of Marxist political ecology, arguing that it had gained a rigidity of thought that prevented its practitioners from exploring the true underlying causes of environmental and ecological problems. They argue that the primacy of political-economic concerns within Marxist political ecology “is a prescription for question-begging research (i.e., for concentrating on factors assumed in advance to be important and for thus missing both other factors and the complex and contingent interactions of factors whereby environmental changes often are produced)” (p. 168). In other words, Marxists know the answers before they know the question.

Even today, the continued influence of Marxist thought on political ecology is still of enough concern that Walker (2006) addresses the topic specifically in his discussion of political ecology’s contribution to public policy. He suggests that a broadened understanding of the forces driving ecological change beyond a purely Marxist analysis is needed and even that it may be necessary to downplay the Marxist legacy within political ecology if it is to gain a seat at the wider policy table.

None of this should be interpreted as anti-Marxist. Many of the processes of social and economic marginalization have been well analyzed by political ecologists operating in Marxist vein, however there is no reason to assume that social and ecological marginalization is a result of specifically Marxian processes. To assume so is either to commit the fallacy of affirming the consequent or to succumb to Vayda and Walter's (1999) accusation of begging the question. The question arises as to what can take complement the Marxian tradition, if indeed it is too constraining or inflexible. Cumbers and Routledge (2004) touch on one suggestion:

“In searching for alternatives to neoliberalism it is important to avoid past mistakes, especially the dangers of totalising discourses; central planning and an over-determined Marxism are no substitute for market individualism and economic rationality (Cumbers 2003; Hodgson 1999). Whilst it is critical to hold on to some basic global principles of environmental, social and distributive justice (Fraser 1998), the search should be for a plurality of alternatives that in turn reflect the diverse and differentiated contexts of particular struggles.”
(p. 819)

Rather than building our understandings of injustice on a theoretical foundation of rigid ideals and solutions to those injustices on idealistic quests (a world without capitalism), I argue that a nascent theory of environmental justice can be meaningfully combined with political ecology to provide a more flexible understanding of how environmental injustices occur while incorporating a more general understanding of how in-group/out-group dynamics aid the generation of environmental injustice. This nascent theory has been developed and expounded by Nussbaum (2006), Fraser (2003), and many others, but most concisely argued and summarized by Schlosberg (2007).

The theory emphasizes the real-world, empirical understanding of the *why* of environmental injustice, so that injustices can be remedied when and where they occur (Schlosberg, 2007). It is based, though not wholly embedded, in liberal Rawlsian thought, which may upset more traditional Marxist political ecologists because “liberalism had its origins in capitalism and its need for free markets in labor and private ownership

and control of real capital, including the means of production” (Freeman, 2007, p. 43). Indeed Swyngedouw and Heynen (2003) oblige, specifically criticizing Rawlsian thought as being focused on solely distributional concerns.

Although he writes in the broadly Rawlsian tradition, Schlossberg (2007) would agree. Without downplaying the importance of the maldistribution of both tangible and intangible “bads” and “goods” within a society, Schlosberg (2007) builds on the Rawlsian tradition by incorporating two additional factors needed for generating environmental injustice: lack of recognition, and lack of participation in environmental decision-making.

Recognition is the way in which individuals and groups are recognized in society as equal human beings, deserving of equal status in social interaction. Fraser (2000) describes it thusly:

When [social actors are seen as] inferior, excluded, wholly other, or simply invisible — in other words, as less than full partners in social interaction—then we can speak of misrecognition and status subordination. From this perspective, misrecognition is neither a psychic deformation nor a freestanding cultural harm but an institutionalized relation of social subordination. To be misrecognized, accordingly, is not simply to be thought ill of, looked down upon or devalued in others’ attitudes, beliefs or representations. It is rather to be denied the status of a full partner in social interaction, as a consequence of institutionalized patterns of cultural value that constitute one as comparatively unworthy of respect or esteem (p. 112-3).

Participation refers to the decision-making capabilities of a group or individual. In Rawls’s thought, equal participation is one of the five “basic liberties” – those that cannot be infringed upon except in defense of each other. This liberty must “be maintained by governments’ taking measures to equalize individuals’ political standing and influence, and by not allowing concentrations of wealth and power to distort the democratic process” (Freeman, 2007, p. 469).

The three factors, distribution, recognition, and participation are closely intertwined and ultimately inextricable:

“The point here is absolutely critical: it is not just that political and cultural institutions create conditions that hamper equity and recognition, but that both distributive inequity and misrecognition hamper real participation in political and cultural institutions” (Schlosberg, 2007, p. 28).

Without participation in environmental decision-making, a community cannot address distributional concern, but without recognition, a community cannot participate. Recognition is generated or denied primarily through social networks and not through state apparatuses; so, any understanding of a particular environmental injustice must encompass not just the role of the state, which may only have control over distributional aspects, but of social relations between groups in a society.

In fact, environmental justice movements inevitably tie their demands for justice to demands for recognition: “Environmental justice activists often see their identities devalued and make a direct connection between the defense of their communities and the demand for respect” (Schlosberg, 2005, p. 101). In the US, this is unsurprising, given the growth out of the civil rights movement that at its core is a demand for recognition, but this demand occurs in the global South as well. The well documented case of the Ogoni people of Nigeria’s resistance to Shell Oil illustrates the principle: the construction of a pan-Ogoni identity under British colonial rule was a key prerequisite for the later creation of the Movement for the Survival of the Ogoni People (Isumonah, 2004). Demands for recognition preceded the demands for environmental justice.

It is these three factors – distribution, participation, and recognition – that my research seeks to test. At the risk of falling prey to Vayda and Walter’s (1999) question begging criticism, I designed my research to look at these factors in a real-world setting. However, the tripartite theory of environmental justice, on its own, makes no account of the scale or the context of particular instances of environmental injustice. If we are

to understand any particular environmental injustice, we must have a framework for analyzing it, for understanding how and why a particular group is negatively affected. This is the gap that political ecology fills – by putting a particular injustice in its broader historical, political, and economic contexts, we can gain a better understanding of how maldistribution, misrecognition, and denial of participation occur. It is this tactic that I employ when studying e-waste in Accra. At this point, it is worthwhile to take a look at what research political ecologists have performed with regards to waste in other contexts.

2.5. Political Ecology and Waste

Some recent political ecology work has begun to address the issues of waste management and environmental injustice. For instance, Parizeau (2006) proposes a political ecology approach to health concerns not dissimilar to the one I present in this thesis. She argues that local scale exposures to environmental harm are a product of larger scale processes, and that these environmental exposures are mediated through networks of social capital to produce specific health outcomes in the health of waste pickers in Latin America.

In a more detailed analysis, Njeru (2006) illustrates how the complex interactions of culture, economics, and municipal government create a serious and inequitable distribution of discarded plastic bags in Nairobi, Kenya. In the political ecology tradition, he emphasizes cultural aspects of consumption, the economics of bag production and waste disposal, and the historical basis of the political power of the bag manufacturers, which has prevented action to address the problem.

There are enormous numbers of plastic bags produced and consumed in Nairobi and because of inadequate waste management ability, they are often discarded in the streets, causing not only visual, but chemical pollution. Few consumers find the plastic bags pollution to be a cause for concern; they see plastic bags as desirable because

they allow them to show off their consumption “by revealing what they carry in their bags” (Njeru, 2006, p. 1051). Retailers are happy to oblige consumers’ demands, but to save money they use very thin plastic bags, which are generally good for only one use, compounding the pollution problem. Those consumers that do see a problem with plastic bag waste blame the producers of the plastic bags – after all they make the bags and have the financial resources to clean them up.

However, the wealthy Kenyan-Asians who own most bag manufacturing companies do not see themselves as playing a significant role in the bag waste problem, and they have wielded their political influence to prevent real action. The only notable effort made is the national government’s ban on too-thin bags. At the local level, the city government has essentially abdicated waste management responsibility to privatized garbage collection firms that indiscriminately dispose of waste in low-income areas. It is the combination of all these factors that leads to poor and marginalized communities’ disproportionate burden of plastic bag waste.

Finally, Myers (2005) writes extensively, and ultimately pessimistically on the intersection of neo-liberal conceptions of sustainability, government, and solid waste management under the auspices of the Sustainable Cities Program of the United Nations. Although Myers does not discuss it, Accra is also one of the sub-Saharan African Cities targeted under the Sustainable Cities Program. The success of the program in general has been mixed, and Accra is one of those cities where implementation of the Sustainable Cities Program has been less than ideal (Njeru, 2006).

2.6. Accra and Waste Management

Solid waste management in Accra is inadequate, and most of the research done on waste in Accra approaches attempts to address this inadequacy from a technical perspective with little or no input from the residents of the city (cf. Anomanyo, 2004; Boadi, 2004; Boadi & Kuitunen, 2003; Demanya, 2007; Porter & Boakey-Yiadom, 1997).

Only high-income and some middle-income residents regularly receive trash collection services. The poor are left to manage waste themselves (Boadi & Kuitunen, 2003) and consequently suffer significant negative health impacts relative to the richer areas of the city, including increased incidence of diarrhea, dysentery, pests, upper respiratory infections, and decreased indoor air quality (Boadi, 2004; Songsore et al., 2005). Lacking municipal trash collection services, many poor and low-income residents rely on the services of informal waste collectors, who transfer waste to both legal and illegal dumpsites. In Accra, 18% of households burn their waste in communal open-pits, giving toxics (including those from e-waste, if there is any) more opportunity to leech into groundwater (Boadi, 2004).

Notably, earlier research in Ghana on community perceptions of urban waste showed it to be of little concern to residents of Techiman, a city in west-central Ghana (Mensah & Whitney, 1991). Yet, in at least one incident, suburban residents of Accra blocked access to existing dumpsites to protest the possible creation of new dumpsites in their community, out of fear that the unhygienic conditions of these landfills would lead to outbreaks of disease (Boadi & Kuitunen, 2003). This is a clear demand for participation in environmental decision-making. The question then is what, if any, risks do communities affected by e-waste perceive, and if they do perceive risks, do they have meaningful methods of participation in decision-making. If they do not, then why do they not?

If Accra had adequate solid waste management, it is unlikely that there would be a problem from e-waste outside of the landfill (the problem currently faced by countries of the North). But because solid waste management is inadequate, the residents of Accra are forced to turn to informal means of disposal and more importantly, informal means of waste recycling – including e-waste. It is these informal recycling methods and their environmentally unjust effects on communities that this research examines.

2.7. Summary

In this chapter I have reviewed the relevant literature on the topics of electronic waste, political ecology, environmental justice, and waste management within Accra, Ghana. I argued that improper e-waste recycling presents a real health hazard and when improperly disposed of or recycled can lead to the creation of environmental injustices. I proposed that a political ecology framework, when combined with a nascent theory of environmental justice, provides a more powerful theory for understanding how environmental injustice occurs in relation to e-waste in Accra. It is around this approach that I designed the research presented in this thesis. In the next chapter, I discuss the research setting, methods used to collect data, and the methods used to analyze the data.

Chapter 3: Methods

3.1. Introduction

This chapter introduces the methods used in the research study. It consists of the research design, a description of the study area and the participants, methods used to collect data, and the methods used to analyze the data. The research was done in two parts, the bulk of it took place in Accra during the months of May and June, 2007. Phone interviews with organizations in the United States and the United Kingdom were conducted between August and October 2007.

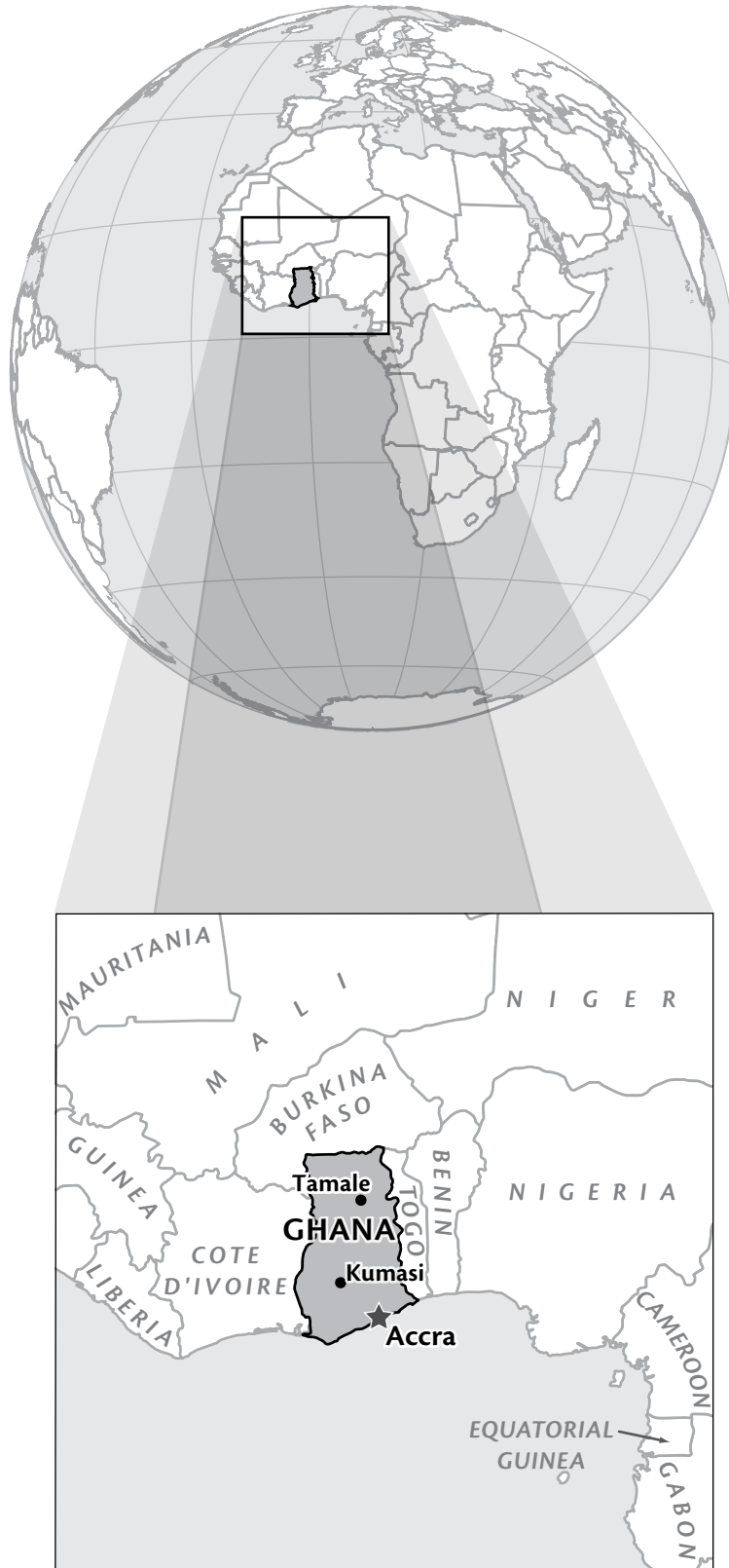
3.1.1. A Note on Currency

Research in Accra was done in May and June of 2007. At that time, one U.S. dollar would buy 9300 cedis. This is the exchange rate used in this thesis. On July 3, 2007, the cedi was redenominated as the Ghana cedi, removing four zeroes from the original, so one U.S. dollar would buy 0.93 Ghana cedis. All cedi amounts in this thesis use the non-redenominated values.

3.2. Research Design

3.2.1. Research Questions

In this research, I use a political ecology framework described in the previous chapter. Political ecology attempts to place the multi-scalar processes that shape human-environment interactions in their broader historical, political, and economic contexts. I argue that, when combined with nascent theories of environmental injustice, political



Map 1: Ghana in the World

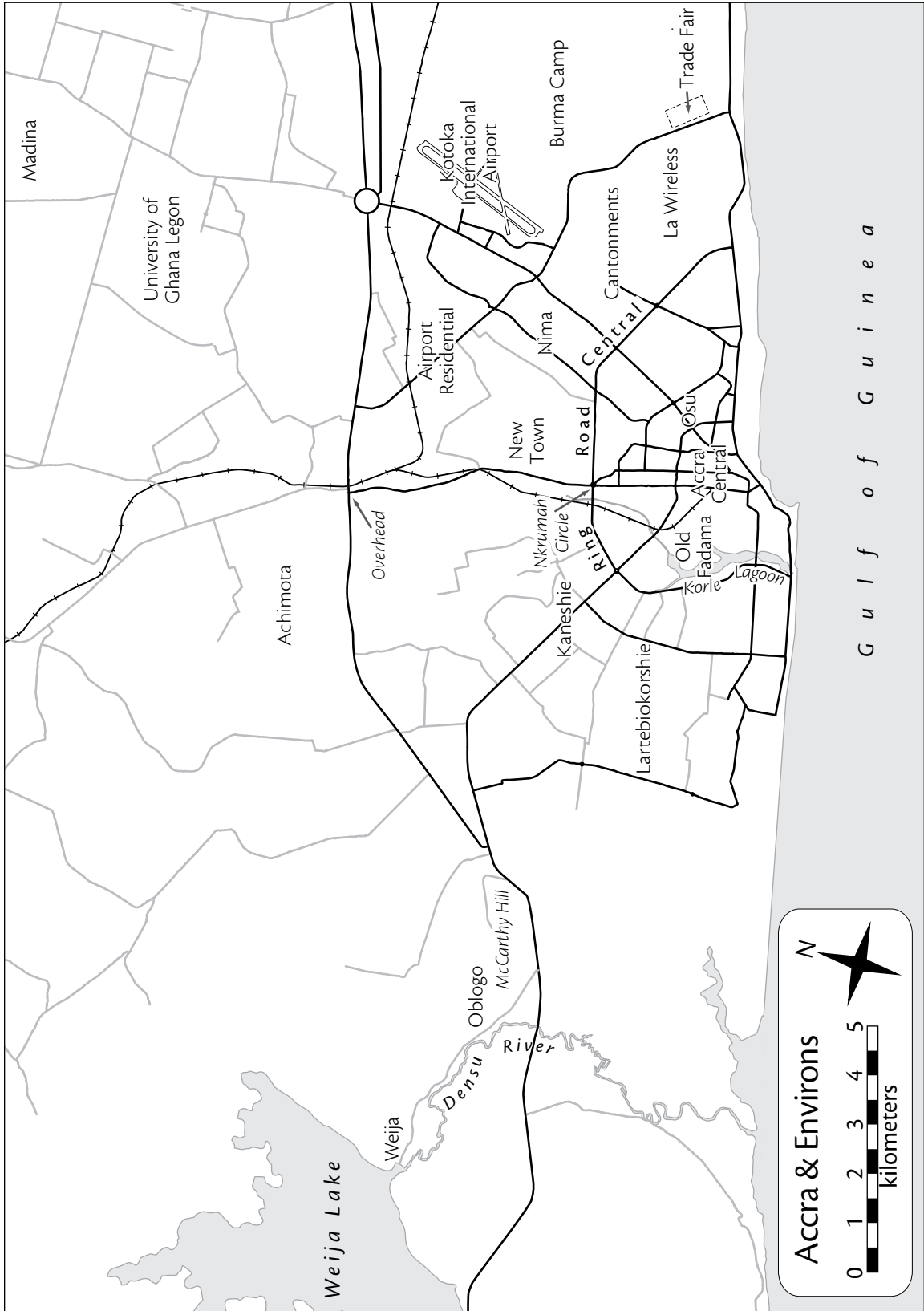
ecology is particularly well suited to understanding the generation of environmental injustices.

The particular human-environment interaction I examine is the fate of computer equipment donated from the global North to the South. These donations, though tangibly beneficial, may have unintended and unanticipated consequences, such as exposing children to lead, causing ground water pollution, or workplace hazards. Recipient countries usually lack adequate facilities to safely reprocess the toxic materials contained in this equipment. When the computers inevitably fail, they are discarded, typically in or near poor communities. These communities are not chosen at random, but are instead the result of specific processes of social, economic, and political marginalization. These processes are often opaque to donor organizations operating in the global North, which may unknowingly contribute to an environmental injustice.

To understand these processes, I designed my research around six research questions. First, where do donated computers come from and to whom do they go? This raises several sub-questions, including how the donors acquire and distribute the computers they donate, and how aware are they of the e-waste problem. Second, what happens to computers between arrival in Ghana and disposal? Third, where are computers dumped, and who are the people that live near them? Fourth, what are the social and economic dynamics surrounding the dumpsites? Fifth, are people who reside or work near the dumpsites potentially exposed to risks from e-waste? Finally, is there any awareness of the risk inside or outside of the community and are the communities' concerns being meaningfully addressed?

3.3. Research Setting

I performed this research in the City of Accra, Ghana. Ghana is a relatively small country on the Gulf of Guinea in West Africa. In 2004, the country had a population of approximately 21.7 million, some 47% of which live in urban areas (UNDP, 2006). The



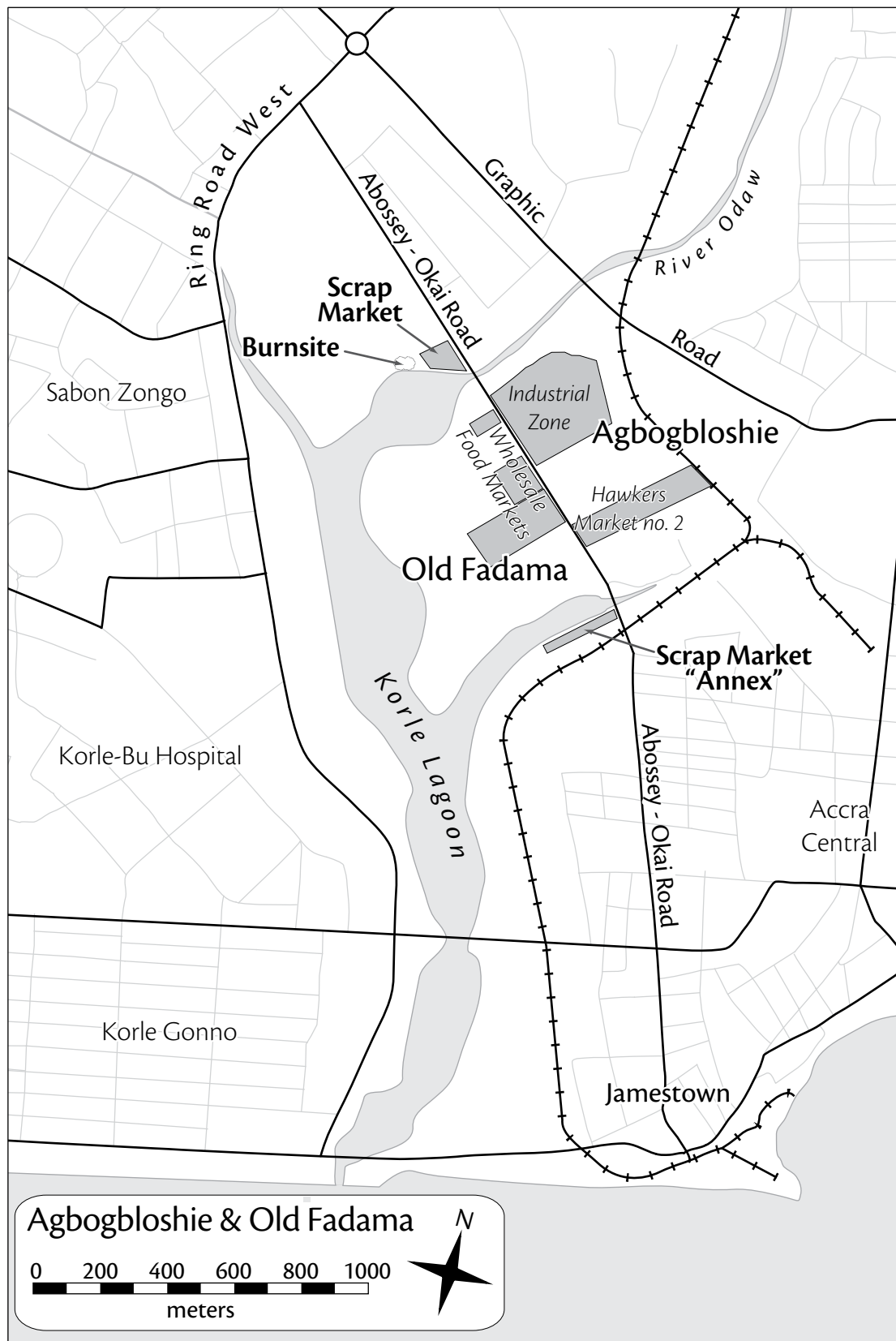
Map 2: Accra and Environs

country has four primary ethnic groups, the Akan (often called Ashanti after the largest sub-group) (44.1%), Mole-Dagbane (14.4%), the Ewe (13.0%), and the Ga (8.3%). Very roughly speaking, the Ga are centered on the coast, girdling the Greater Accra area, the Ewe reside to the east of Lake Volta, primarily in the Volta Region and into neighboring Togo. The Mole-Dagbane peoples occupy the Northern, Upper East, and Upper West Regions; the rest of the country is majority Akan (von Gnielinski, 1986).

The largest urban area is the capital city of Accra, with some 1.7 million residents in 2000, a number expected to increase to some 4 million by 2020; at independence in 1957, the city had only 190,000 residents. The city sits on the Gulf of Guinea at the edge of the coastal plains, spanning some 25 km east-west and 12 km north-south. Accra remained an undistinguished trading post until the late nineteenth century, when it became the colonial capital. This precipitated a rise in the city's importance and population.

Growth increased rapidly after independence, when successive national leaderships concentrated government and parastatal organizations in the town, further increasing its importance. Yet, mismanagement of its rapid growth has led to significant urban problems, such as inadequate planning of new settlements and consequent lack of sanitation facilities (Grant & Yankson, 2003). Thus, Accra itself can be divided into areas of planned growth, such as the Cantonments and Airport Residential areas, and the far larger areas of unplanned growth, such as Nima, Sabon Zongo, and Old Fadama/Agbogbloshie. These areas have much higher density, and rents there are much cheaper than in the rest of the city (Grant, 2006; Grant & Yankson, 2003).

A large portion of this study took place in two locations within the greater Accra area. At the time I arrived, these locations were unknown to me, but early reconnaissance uncovered them, and later work only confirmed these two locations as being key sites of e-waste processing. The first, Old Fadama/Agbogbloshie, (hereafter referred to only as Old Fadama) sits approximately 1km northwest of the old center of town, bounded



Map 3: Agbobbloshie and Old Fadama
Based on Grant (2006)

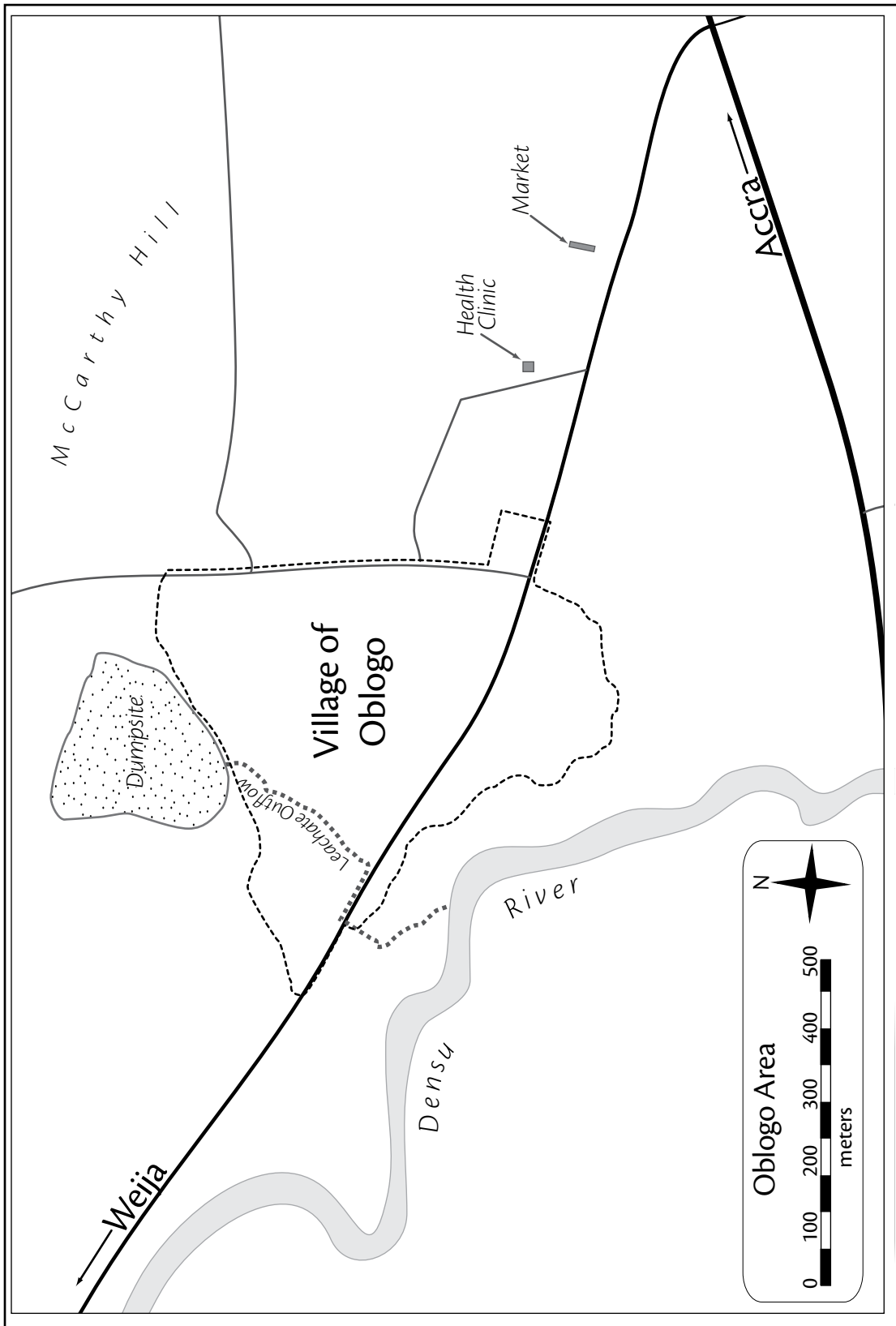
on the northwest, west, and southeast by the Korle Lagoon and the River Odaw that feeds the lagoon. On the northeast, the Industrial Zones and the railway form the boundary. The Abossey-Okai Road bisects the area into Old Fadama on the southwest and Agbogbloshie on the northeast¹. The land and water itself is severely polluted; trash and raw sewage flow down the River Odaw and into the Lagoon. The Korle Lagoon is considered one of the most polluted bodies of water in the world.

Despite the pollution, over the past decade or so, this area has become a commercial hub, housing both the yam and onion wholesale markets on the Old Fadama side, as well as the Accra Brewery and a paint factory on the Agbogbloshie side. The area lacks most sanitation facilities, leading to severe health risks for residents, while the unplanned housing presents a severe risk of fire for residents (Boadi & Kuitunen, 2003; Columbia Architecture Studio, 2003; Grant, 2006).

On the northern side of the river Odaw, along the Abossey-Okai road, the scrap market covers about one hectare. Scrap of all kinds is disassembled into its saleable metals and plastics, car parts, batteries, household junk. The ground is littered with waste that is too small to sell, while enormous piles of saleable materials await collection. A short distance behind the market, trash fires burn. Across the narrow Odaw sits Old Fadama, a patch of land jutting into the Korle Lagoon and holding the wholesale food markets and the shantytown.

Although close to the central business district, this third to half square kilometer of land long had few residents. It was considered sacred by the local Ga, and the colonial city government chose to focus its planning efforts elsewhere. It remained largely empty until the early 1990s, when the population grew rapidly from in-migration by people from the Northern Region fleeing ethnic conflict that involved the Konkomba, Nanumba, and Dagomba peoples. As a result, the majority of the settlement's 30-40,000 residents hail from the north of the country (COHRE, 2004; Grant, 2006).

¹ While some maps make this distinction, it is less obvious in practice. For instance, the Agbogbloshie Scrap Market actually sits on the western side of the Abossey-Okai Road.



Map 4: Oblogo Area

This unplanned immigration has caused significant conflict over the land. The Accra Metropolitan Assembly (AMA) considers the residents of Old Fadama squatters and has tried on multiple occasions to evict them. Citing a 1961 Government of Ghana proclamation that laid claim to the land, the AMA asserts that it wants to use the land for tourist facilities, or a park. Only through the intervention of international NGOs has eviction been prevented. In the popular media, the residents of Old Fadama are regularly vilified as “invaders”, and their community is commonly referred to as “Sodom and Gomorrah” (COHRE, 2004; Grant, 2006).

The second major site in the study is the village of Oblogo, on the western edge of the city of Accra, some 12km WNW of the city center. It lies on the eastern bank of the Densu River, at the western foot of McCarthy Hill, along the road to Weija. It is occupied by a group of Ga who are practicing Muslims. The AMA uses a quarry on the hillside, some 150m from the town, as the official dumpsite for the city’s trash.

3.4. Overview of Acquired Data

The data acquired for this study comes chiefly from interviews, supplemented in places with focus group discussions and a community mapping exercise. The Customs, Excise, and Preventive Service of Ghana (CEPS) provided a dataset detailing shipments of electronics and scrap metals. Lastly, the World Computer Exchange publishes all of their partner materials on their website (World Computer Exchange, 2007). Twenty-four of these partners were in Ghana, and I examine the plans presented by these partners. I describe each of these datasets in turn.

3.4.1. Interviews

I identified six groups of potential participants for this study: organizations collecting and distributing computers, organizations receiving donated computers, used computer dealers, informal waste recyclers, national government officials, city

sanitation officials, and residents of communities near e-waste dumpsites. For each in turn, I will describe the participants, the research technique used, and the method of recruitment. Unless otherwise noted, semi-structured interviews were used for all interviews, as the rigidity provided by formal interviews would not be appropriate to the exploration of an unfamiliar topic. Appendix A contains complete details of the questions used.

I conducted the interviews with government officials, used computer dealers, and donor and recipient organizations alone. My research assistant, Nicholas Cofie, a student at the University of Ghana's Regional Institute for Population Studies, and I conducted the focus groups, mapping exercise, and interviews with waste recyclers together. No recordings were made during the interviews, but detailed notes were taken. Informed consent was obtained by reading of a statement approved by the Pennsylvania State University Institutional Review Board. Consent was only verbal, though I offered a copy of the statement to any individual who wanted one. To protect privacy and elicit honest answers, all interviewees are kept anonymous.

3.4.1.1. Organizations Collecting and Distributing Computers

I interviewed representatives of seven organizations; all were based in either the United States or the United Kingdom; five interviews were conducted over the phone, and two interviews were conducted with a representative based in Accra. The interviews each lasted 20-60 minutes. Through these interviews, I hoped to gain an understanding of how computers were acquired and distributed and what, if any, appreciation the organization had for the issue of e-waste.

I recruited participants either by contacting the organization through phone or e-mail, except for two interviews that were done in person in Accra. Participants were given the option to review the notes of the interview after they had been typed and to make any corrections or clarifications. The organizations were identified in two

ways. The first as by using the Internet, searching for organizations engaged in bringing computers to the global South – these are the five interviews conducted by phone. The second way was using the database provided by CEPS, described in detail below. This database contained the sending and receiving organizations for each shipment of computer equipment. If a shipper's or a recipient's name gave some indication that the organization was involved in non-profit work, then I attempted to contact representatives. These are the two interviews performed in Accra.

3.4.1.2. Organizations Receiving Donated Computers

Because the organizations that receive donated computer equipment are primarily responsible for its disposal, I needed to learn how they managed the computers they received and how they disposed of them, as well as their own awareness of e-waste concerns. Locating these groups was much more challenging. Most of the organizations listed in the previous section do not give details about which organizations they send computers to. Nonetheless, three organizations in Accra were identified, one was a school and orphanage; the second was an NGO who had worked with an organization in the United States (who was also interviewed). The final was with a representative of the Ministry of Education, which, as will be shown, is the direct or indirect beneficiary of a substantial portion of donated equipment. Initial recruitment was done by phone for all participants. All interviews were conducted in person in Accra, in the offices of the individual, and they lasted between 30-60 minutes. As above, all participants were given the option to review the notes via e-mail.

3.4.1.3. Used Computer Dealers

Used computer dealers and repairers make up the second group primarily responsible for disposal of computers. I wanted to learn how they managed discarded or irreparable equipment and how aware they were of e-waste concerns. I located

them using newspaper ads, word-of-mouth, and by personal reconnaissance of retail locations. A conscious effort was made to get dealers in a variety of locations in the city. In all cases, I recruited the participants by visiting the retail location and asking to speak with the person in charge of the store. Eight 10-20 minute interviews were conducted: one in the La Wireless neighborhood, two near Nkrumah Circle, one in Old Fadama, two in Osu, one in Trade Fair, and one in Lartebiokorshie. The residents of these areas vary from the very poor in Old Fadama to the relatively well off in Osu.

3.4.1.4. Informal Waste Recyclers

Because of the inadequate formal waste collection in Accra and the valuable commodities contained in discarded electronics, informal waste recyclers contribute significantly to e-waste recycling in the city. From them, I wanted to learn where e-waste was discarded, what the social and economic dynamics surrounding the dumpsites were, what their perceptions of health risks from e-waste were, and how these effects were (or were not) addressed. The informal recyclers fell into three categories: the first were roaming scrap collectors, the second were dealers in the scrap market at Agbogbloshie, and the third were scavengers at the dumpsite in Oblogo.

Both the roaming scrap collectors and scrap dealers were initially contacted at the scrap market at Agbogbloshie. Later interviews with scrap collectors were conducted at various places on the streets of Accra. Overall, twenty-one interviews were conducted with scrap collectors, and eight with scrap dealers, including the head of the Scrap Dealers Association. Six interviews took place at the Agbogbloshie scrap market and two at the “annex” to the market on the other side of the lagoon. All participants were men, and their ages varied from late teens through middle age. The interviews typically lasted 10-30 minutes.

We also performed a “mental model” exercise with one group of eight scrap collectors near the entrance to the Agbogbloshie scrap market. With a mental model,

the researcher attempts to elicit people's perceptions of a particular risk, which is often different from the researcher's perception of that risk (Zaksek & Arvai, 2004). Our goal was to learn what people working in the scrap market perceived as the health risks from the smoke that comes from burning e-waste. As described later, burning electronics to remove insulation and other non-saleable components is a key part of the e-waste cycle. For this exercise, a large sheet of paper was divided into one half and two quarters. On the first half of the page, the group was asked to describe which waste materials were burned. After they had finished describing the things that were burned, they were asked to describe some of the "good things" and then some of the "bad things" that came from the smoke.

The scavengers at Oblogo differ from the roaming scrap collectors described above. They work in one location, the Oblogo landfill, but they are seeking the same materials: metals and plastics. We made initial contact with two scavengers at the landfill in Oblogo simply by paying a visit and speaking informally, but it soon became clear that further interviews would require the consent of the AMA's Waste Management Department (WMD). After this permission was obtained, we conducted a 30-minute interview at the dumpsite with the four leaders of the scavengers union. All of the union leaders were present at the same time, and the representative of the WMD was at the dumpsite, but was at some distance. It is difficult to know whether the representative's presence influenced the scavengers' answers. My own observation indicates the relationship was respectful and friendly, and the interviewees did not indicate that it was a problem.

3.4.1.5. National Government Officials

In order to understand how the government views potential e-waste problems, addresses community concerns, and manages sanitation, I sought interviews with the appropriate officials. Interviews with this group and the following were arranged with the

assistance of Emmanuel Tachie-Obeng, then an employee of the Ghana Environmental Protection Agency (EPA). The first interview lasted 45 minutes and was with two Senior Program Officers in the Built Environment Department of the EPA. Both were present at the same time. The Built Environment Department is responsible for public health, human settlement planning, and disaster management. The interview was conducted in the offices of one of the officers. The second interview was with the head of the Sanitation Division at the Ministry of Local Government, Rural Development and Environment. This division is responsible for setting national standards on sanitation services. This interview took place in his office and lasted approximately one hour.

3.4.1.6. City Sanitation Officials

There was one informal, yet quite informative, interview with an WMD employee that occurred while waiting in the offices of the WMD in Kanishie. Two other informal interviews took place in the weigh station at the dumpsite in Oblogo. One semi-structured interview was performed over two days with the head of the WMD of the AMA, both sessions combined to about 60 minutes.

3.4.1.7. Residents of Old Fadama

Nicholas and I arranged with some residents of Old Fadama to have a focus group discussion and mapping exercise. We made initial contact by visiting Old Fadama, where we were quickly brought to a group of elders. We introduced ourselves and returned a few days later to make arrangements for the activities. The group of elders recruited the participants, as is culturally appropriate. We asked for 10-12 participants, with an even mix of men and women; substantially more than that showed up. They were broken down as follows:

- 6 scrap dealers
- 4 students

- 1 electronics repairman
- 9 head porters (all the women and no men were in this group)
- 2 photographers
- 3 circumcisionists

Two activities were conducted: a community mapping exercise followed by a focus group discussion. In order to keep the discussion more manageable, we asked that only a small subset of people be allowed to actively participate in the focus group, though everyone was invited to observe; four women and six men participated. Both activities took place under a shade structure frequented by the elders on the southwest side of Old Fadama, across the water from the “annex” to the scrap market. All told, the exercises (including a break for refreshments) lasted about two and a half hours, the mapping exercise about 45 minutes and the focus group about 60.

Participatory mapping exercises are increasingly common. They have been used in a wide variety of applications, including health mapping, sanitation, nutrient flows, and crime prevention (Chambers, 2006). They provide an opportunity for participants to collectively express their knowledge of a place by situating themselves in their environment (Ayala, Maty, Cravey, & Webb, 2005). By working in a group, there is a built in “sanity check” as the method involves not only input from but corrections by the other participants (Keith & Brophy, 2004). Glöckner et al. (2004) describe a surprisingly detailed set of maps created by a community members in Dar es Salaam of their water and sanitation services and needs.

In the mapping exercise conducted in Old Fadama, we took a large sheet of paper and distributed markers to the participants. Because we had only six markers, and the 25 people listed above in attendance, we made an effort to let anyone draw if they wanted to. Overall, the women were much less willing to participate than the men. We were told it was because they were illiterate and uncomfortable with writing, but it seems likely that gender roles were a factor as well; to participate would have required

a certain amount of assertiveness from the women, given the large number of male participants. For the exercise, we asked participants to draw the boundaries of their community; next we asked women and men to separately add their favorite places and then places of safety and of danger. Throughout the process, participants were queried on why they chose to list what they did on the map.

After the mapping exercise, we conducted a focus group discussion. Unfortunately, the amount of participation from the women was limited, partially owing to the language issues, but an element of patriarchy was evident, as well. It was only at our prompting that the women came to the front of the group, instead of back where they usually sat. The men who participated in the focus group had been residents for much longer than the women – seven years on average versus four months, as well as much older – 30 years old versus 19 years old.

During the focus group, we asked questions related to the town, the scrap market, knowledge of e-waste, and the residents' relations with the AMA. At the end of the activities, a brief discussion was held explaining the risks from e-waste, in particular lead. We also distributed fact sheets to people in attendance, with a special emphasis on explaining their contents to the women since they bear more of the child-raising responsibilities, and children are at particular risk from lead. The fact sheet outlined in simple language some of the hazardous materials, their negative effects, and pathways of exposure. More detailed information was given on the reverse side. This fact sheet is reproduced in Appendix D.

3.4.1.8. Residents of Oblogo

Discussions with residents of Oblogo occurred several times. Individuals were approached and asked to participate, yielding interviews with three people: a village elder, the local fetish priest, and a retired chief's linguist². Given the nature of the landfill,

² The chief's linguist (Ga: *otsame*) is the chief's spokesperson. In official functions, the chief does not speak directly to those assembled, instead his words are relayed through the *otsame* (Yankah, 1995).

the discussions did not focus on e-waste in particular but on waste in general, and the participants' experiences with the landfill and the AMA. While most of these discussions were informal, one impromptu focus group discussion occurred with a group of eight men of the village. The same questions used in Old Fadama were used in Oblogo.

3.4.2. Other Data

3.4.2.1. Customs Data

Two databases were provided by the Customs, Excise and Preventive Service of Ghana (CEPS): the first lists imports and exports of computer equipment and the second lists all imports and exports of scrap metal. The database contains all shipments processed by CEPS since November 2002, when CEPS computerized the processing system, up to June 28, 2007. The early months of data show far fewer shipments than later months, implying that the computerization project took a few months to be fully implemented. Therefore, only entries more recent than January 2003 are used for most

Table 1: Harmonized Customs Codes used for scrap metal

Code	Description
7112.30	Waste and scrap of precious metal or of metal clad with precious metal
7112.92	Waste and scrap of precious metal or of metal clad with precious metal
7112.99	Waste and scrap of precious metal or of metal clad with precious metal
7204.49	Ferrous waste and scrap
7204.41	Turnings, shavings, chips, milling waste etc of iron or steel
7204.21	Waste and scrap of stainless steel
7204.50	Remelting scrap ingots
7204.29	Waste and scrap of alloy steel (excl. stainless)
7204.30	Waste and scrap of tinned iron or steel
7204.10	Waste and scrap of cast iron
7404.00	Copper waste and scrap
7602.00	Aluminium waste or scrap
7802.00	Lead waste and scrap

calculations. For the scrap data, no entries appear before March 2004. It is not clear why this is so.

Each entry in both the databases contains information on the shipper, receiver (including name and address), the declared value (cost, insurance, freight), the duty levied (and related exchange rate information), the mass of the shipment, the number of packages in the shipment, the port of entry, the date of the shipment arriving in the country, the country of destination and origin, and the Harmonized Custom Code (explained below) applied to that shipment. Each item in a shipment must be classified using a Harmonized Customs Code. Defined by the World Customs Organization and widely adopted around the globe, these six digit numbers hierarchically describe the type of good being imported or exported. For instance, the code '7404.00' refers to Chapter 74, Section 4, and no Sub-section of the Harmonized Customs Code. In this case, Chapter 74 describes "Copper and articles thereof," while Section 4 refers to "Copper waste and scrap." For scrap metal, the database provided by CEPS has 1623 entries under the 13 codes, shown in Table 1.

Unfortunately, there is no single code for computer parts under the current classification system, and no distinction is made between used and new equipment, although most computer equipment falls into chapters 84 and 85 of the code. Together, these two chapters make up Section XVI titled: "machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles." Because of this difficulty, I decided, in concert with the customs official generating the data, to select all shipments where the description field contained the word "computer." This generated 53,392 entries under 510 codes (these codes are not listed for the sake of brevity). Not all of these entries refer specifically to computer equipment, for instance "computer table" is one entry. That being said, most entries are for computer equipment specifically. When using only entries that fall under Chapters 84 or 85, the number

shrinks to 49,727 entries with 246 unique codes. If this is further limited to those entries where the description field contains the word “used,” then there are 31,470 entries with 134 unique codes.

While this data is largely accurate, it should not be thought of as completely accurate. I deleted a number of erroneous entries from the database. For instance, several shipments of 20,000-50,000 packages of cashews were classified as scrap metal and one shipment of three computers was recorded as having a mass of some 1.2 million kilograms. The number of entries in the scrap table is small enough to inspect each entry manually to remove obviously incorrect data, such as the cashew shipments. For the computers this is much less feasible, so for each entry, the Z-score for the netmass was calculated and entries with a Z-score higher than four (representing 0.13% of the data) were examined for correctness and erroneous entries were removed. Incorrect data undoubtedly remains; so all numbers derived from this data should be considered approximate.

All statistical analysis of the data was done using R version 2.6. In addition to providing cross tabulations of all the data, and generating charts, a time-series decomposition by loess using the `stl()` function was performed on the scrap metal exports, to see if there was a seasonal pattern to the exports. The normality of the residuals produced by the decomposition was tested using the Shapiro-Wilk test.

3.4.2.2. World Computer Exchange Plans

The World Computer Exchange (WCE) publishes on its website all official documents for the organizations they work with (World Computer Exchange, 2007). These include shipping documents, invoices, and implementation plans submitted by the partners. Before they will transfer computer equipment to a partner, WCE requires each potential partner to submit an implementation plan that includes answers to specific questions. One question asks the potential partner to describe their plan for

disposal of the computer equipment at the end of life. Between July 2001 and October 2007, twenty-four organizations in Ghana submitted plans, twenty-three of which were approved by WCE's board of directors. However, only three plans seem to have been carried out. All twenty-four plans were examined with regard to what type of organization was receiving the computer and their reported plan for disposal.

3.4.3. Analyzing Interview Data

Field notes were typed into Microsoft Word at the conclusions of each day's exercises. Interview and focus group notes generally followed the flow of the conversation. Notes from the mapping exercise recorded in what order people drew items on the map, who drew them, and the comments made during the drawing, as well as notes from the questions asked after the drawing was complete. Upon return to the United States, I coded the notes based on location of the activity, participants, and the major themes of the research (Frechtling & Westat, 1997). These codes were later used to locate the relevant sections for inclusion in this thesis. Where it made sense (e.g. counting participants), this data was aggregated into tables in Microsoft Excel.

3.4.4. Conclusion

In this chapter I have described the research setting, outlined the research questions that drove the methods, presented the structure of those methods, and how the data generated was analyzed. In the next chapter, I present the results of the research.

Chapter 4: Results

4.1. Introduction

In this chapter, I present the results of my research. I present the results in a “lifecycle” order, meaning I follow the electronic waste from its origin in the North to Ghana, then within Accra to its ultimate disposal. This lifecycle is shown in Figure 1. While the lifecycle is complicated and interweaving, this narrative must be linear. Thus, I begin with the donors of computer equipment, and then I describe the organizations that receive computers and how they maintain systems and manage disposal. Next, I discuss how computer dealers and repairers deal with scrap equipment. At this point, I describe how formal waste management in Accra functions, as a lead into the two paths that e-waste takes as it approaches final disposal. These two paths lead to the AMA’s landfill in the village of Oblogo and Agbogbloshie Scrap Market and neighboring Old Fadama. For reasons that will become clear, it is difficult to make a distinction between the residents and the waste that surrounds them, so the final two sections focus on each of these locations.

4.2. Organizations Collecting and Distributing Computers

I hoped to learn three primary things from these organizations: where their computers came from, and how aware they were of the potential problems with e-waste and how they managed those potential problems. But I also learned how these organizations manage operations in the foreign country and in their home country. Four of these organizations focus on distributing computers to the global South while the other three have brought computers as part of their other charitable work.

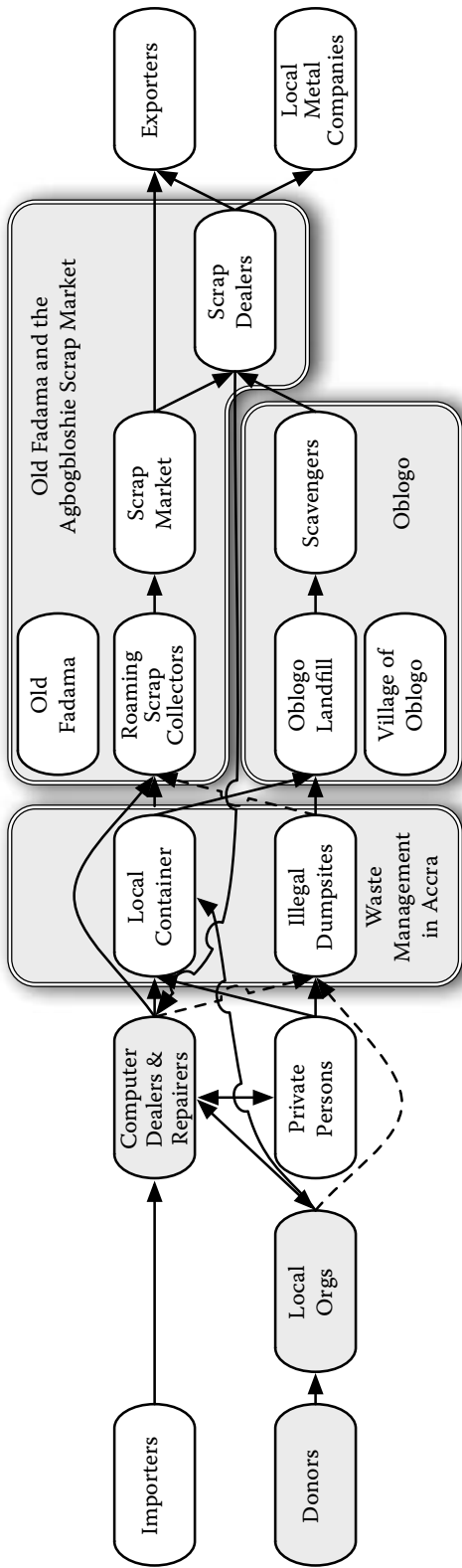


Figure 1: Lifecycle of electronic waste in Ghana
Gray boxes indicate sections of this chapter.
Dashed lines indicate suspected, but unconfirmed paths.

4.2.1. Summary

For the organizations that have brought computers to the global South as part of their other charitable work, there is little awareness of e-waste hazards and, consequently, little effort to address concerns. In contrast, organizations that focus on distributing computers to the global South have a much higher awareness and concern for issues of e-waste, particularly those three who are most “hands on” in the day-to-day operations of the computers they donate. Three of these four organizations strongly prefer uniform configurations in donated equipment, which increases overall lifespan, and they have higher requirements for and do more rigorous testing of donations they will accept. Also of concern to these organizations was the noted existence of essentially junk computers transported under the guise of charity, an obvious attempt to subvert the strictures of the Basel Convention, a phenomenon previously noted in non-charitable contexts (Heller, 2007). All four organizations were concerned with e-waste hazards and had attempted to ameliorate concerns, though only one has a comprehensive recycling program. The others largely depend on local scrap markets, though none had a clear idea of how those operated.

At the donor level, the research questions address the topic of recognition of potentially e-waste impacted peoples. It seems that a charitable focus on computer distribution in the global South leads to a much greater awareness of and concern for e-waste hazards when compared than charitable organizations that do not share this emphasis. However, for economic and practical reasons, there is only some effort made at the donor end to address the hazards. In the remainder of this section, I expand on the results.

4.2.2. Sources for Computers Equipment

The origin of computer equipment varies widely, with little consistency between large and small organizations. Typical sources were from individual donations, businesses, and governments (particularly schools). However, one pattern did emerge: organizations that were focused on distributing computers and more closely responsible for managing or helping to manage day-to-day operations in the foreign country (three of the seven) preferred uniform configurations in the system they accept.

Uniform hardware configurations make management much easier, particularly for hardware maintenance but also for creating standard operating system installations. One interviewee commented that in one country they had 102 out of 105 computers still operational after two years, which he said would not have been possible with a “random hodge-podge” of equipment. In order to get this kind of standardization, these organizations preferred to get donated equipment from sources that can provide a significant number of identically configured computers, typically large businesses, schools, or government organizations.

Organizations that do not have in-country operations but instead consolidate and distribute equipment to other organizations provide or have in the past provided computers for some respondents. Interviewees reported working with World Computer Exchange (WCE) in the United States and Computer Aid International in the United Kingdom.

Several organizations reported having minimum standards for the computers they accept; again these were typically the organizations that focus on distributing computers. The standards are generic classifications such “Pentium II or newer” (two organizations) or “Pentium III or newer” (two organizations). No organization reported requirements higher than a Pentium III¹. Organizations who do not focus on computers

¹ The processor type can be used as a rough guide to the age of a computer. For general desktop use, when a new generation of processor is released it can be assumed to become the de facto standard for new desktops within a few months. The Pentium 4 was released in November, 2000, the Pentium III

did not have minimum standards. One interviewee reported, “We’re lucky to get anything. We don’t get fussy about these things.”

4.2.3. Before Shipment

The amount of preparation the computers go through varies. Of the organizations that brought computers as part of their other work (three of the seven), only one reported any kind of pre-distribution testing. As above, organizations focused on helping with day-to-day operations of donated equipment (three of the seven) generally took greater care to ensure proper functioning of equipment before shipping it.

These organizations also tended to work with other organizations in their home country to mutual benefit. Two interviewees reported that they used the equipment to be sent abroad in programs to train high school students in computer repair. The other organization sent at least some of its computers to a similar program for prisoners. These organizations also installed and configured software and networking before they shipped the equipment. The final of the seven organizations did only basic functionality testing. Essentially, they would turn the computer on to make sure it worked. No software was installed, nor were contents of the hard drives examined in anyway.

4.2.4. Economic Aspects of Donations

Operations that focus on collecting and distributing computers (four of the seven) attempt to recover some of their costs through fees charged to recipient organizations. These fees vary; one organization interviewed charges \$65/computer including shipping; another reported paying Computer Aid £40 (\$80) for fully refurbished computers; WCE typically charges \$50-65/computer before shipping.

in February, 1999 and the Pentium II in May, 1997 (Intel Corporation, 2007). At the time this data was collected, a Pentium II would likely be 8 to 10 years old, and a Pentium III 6.5 to 8 years old.

The single largest charge incurred by most organizations is the shipping costs. Most organizations, particularly those focused on computer donations, attempt to fill an entire container solely with computer equipment before shipping. Interviewees consistently reported that a 20' container holds approximately 200 complete systems while a 40' container holds 450 (though one interviewee reported getting only 360 systems in the most recent 40' container). Obviously, shipping costs will vary significantly based on the origin and destination, but some reported costs are shown in Table 2.

Clearly, the cost of donating equipment varies, especially depending on how much volunteer labor goes into refurbishment, but between acquisition and shipping costs, it can be assumed that it costs between \$20 and \$100 to ship each computer to Ghana. A Pentium III based computer system typically has a local resale value of 1.5 to 2 million cedis (~\$160-215)². The price difference leads organizations to allow (or even require) recipients to sell a portion of the computers they donate in order to provide maintenance funds for the remainder of the equipment.

4.2.5. E-waste Management in-country

Six of the seven interviewees reported schools as the destination for the computers they delivered, the seventh did not specify. Most interviewees felt that recipients would

Table 2: Costs of shipping computers to various locations

Origin Reported	Destination Reported	Container Size	Shipping Cost	Approximate Shipping Cost per Computer
US (West Coast)	Africa	40'	\$6,000	\$13
US (West Coast)	Philippines	40'	\$1,400	\$3
United Kingdom	Zanzibar	20'	\$4,000	\$16
US	Ghana	20'	\$4,000	\$20
US	Uganda	40'	\$9,000	\$20

² In contrast, a PIII based computer system in the US has a resale value of \$25-50.

keep the donated computer equipment for as long as possible, even in a non-functional state. Non-functional computers still have parts that can be used as spares in other equipment. This is one major reason reported for having similar hardware wherever possible. Organizations more closely involved in day-to-day operations also provide computer repair training to recipient organizations and work to establish long-term maintenance plans, which helps to minimize waste.

Two interviewees admitted to having not thought of the e-waste issue (in part because they had not been doing it long enough for the issue to come up), while one additional interviewee said it was the responsibility of their partner and was not aware of what was done with old equipment. One organization asks for disposal plans from partners, but does not enforce them. Two of the donor representatives I interviewed reported seeing junk computers arriving in country, sometimes under the guise of donations and sometimes as computers destined for resale.

One interviewee reported that they train their recipients on the risks from e-waste and show them how they can disassemble and sell the parts from the equipment. The interviewee admitted, however, that not all recipients were quite so “scrupulous,” although he reported one success in Ghana where the recipient school disassembled and sold old equipment, using the funds to improve the school.

Another interviewee, whose organization works primarily in rural areas of one African country, feels that there is simply no capacity to handle e-waste at all in that area, though she has heard of a new growing second-hand market for equipment in one of the larger cities. Her organization explored the possibility of creating a e-waste disposal program, but felt it was economically unfeasible at the present.

Only one organization interviewed reported having a comprehensive end-of-life plan. This program is funded out of the maintenance funds that must be provided by the recipient organization. The organization plans for a five-year life span on equipment it donates and is now beginning to replace computers at several locations in Zambia

and Malawi. These computers are collected and shipped to an electronics recycler in Johannesburg, South Africa. It costs the organization approximately \$1500 to send a 20-foot container (around 200 computers) to the recycler. The recycler pays \$500 per container, leaving a cost of about \$1000 (\$5/computer) to be paid out of the maintenance funds.

4.3. Recipient Organizations

4.3.1. Summary

At the recipient level, the research questions are also on recognition of potentially affected persons, and it seems there is little awareness of how e-waste is handled beyond the point where it is passed to scrap dealers or disposed. The above interviews and the following analysis revealed that computers sent to the global South as donations are overwhelmingly intended for schools, especially for use in classroom settings, though some interviewees reported administrative use as well. In Ghana, individual school administrators have a great deal of latitude to dispose of equipment as they wish, and most choose to give them to scrap dealers or dispose of them through municipal waste streams. In the remainder of this section, I provide more detail on the World Computer Exchange (WCE) plans and on the operations of recipient organizations in Ghana.

4.3.2. WCE Plans

I examined each of the twenty-four plans presented to WCE from organizations operating in Ghana. I noted the location, the year the plan was submitted, the physical location where computers will be distributed, the date the plan was approved by the WCE board, what type of organization was receiving the computers, how many computers were requested, and the method of disposal. I also included my own

Table 3: Summary of WCE data

Year	Approved	Recipient	Quantity	Disposal Method	Notes
2001	8-Jul-01	Schools	1300	Not specified	
2002	21-Apr-02	Schools	Unknown	Not specified	
2003	18-May-03	Schools	390	Not specified (schools given responsibility)	Approval contingent on more detail on sustainability in local schools
2003	7-Sep-03	Schools	100	Given to scrap dealers	
2004	25-Apr-04	Schools	180	Not specified	Approval contingent on hours and fees for youth being clarified and number of youth being confirmed
2004	25-Apr-04	Schools	Unknown	Not specified	Approval contingent on clarifying number of youth, revising budget and plan for fund raising, and defining technical capacity
2004	28-Aug-04	Schools	3000	Hold until govt. has a program, doesn't think computers are ever disposed	
2004	5-Dec-04	Schools	220	Given to scrap dealers, burned, or buried	
2005	27-Nov-05	Schools	420	Given to scrap dealers	
2006	5-Feb-06	Schools & Youth Centers	1300	Dig a big hole, but not put the hole near a stream	Approval contingent on fund raising plan and environmentally aware e-waste disposal plan.
2006	26-Mar-06	Schools	20	Given to scrap dealers	
2006	3-Dec-06	Schools	50	Given to scrap dealers, or burned, or buried	
2006	3-Dec-06	Schools	100	Given to scrap dealers	
2006	3-Dec-06	Schools	200	Given to scrap dealers	
2006	3-Dec-06	Schools & Youth Centers	400	"Have plans to dispose properly"	Approval contingent on improved funding/ implementation plan

Table 3: Summary of WCE data

Year	Approved	Recipient	Quantity	Disposal Method	Notes
2007	11-Feb-07	Schools	100	Repair or scrap market	
2007	24-Jun-07	Schools	175	Not specified	
2007	24-Jun-07	Schools		Not specified	
2006	23-Sep-07	Schools	20	Plans long life, will dispose based on consultation with "Environmental Protection Council"	Approval contingent on more technical plans
2007	23-Sep-07	Schools	210	Claims EPA will take them	
2007	23-Sep-07	Schools	Unknown	Not specified	
2007	23-Sep-07	Schools	100	Given to scrap dealers	
2003	NA	Schools	150	Claims no market, assures proper disposal, but no specifics	No approval data given, but website has pro forma invoices, so approval presumed
2005	NA	Schools	Unknown	Not specified	

comments to add relevant details. Overall, there were requests for 8435 computers, all of which were destined for schools or for a combination of schools and youth centers. The results are summarized in Table 3. Nine organizations did not specify a disposal method, nine planned to give computer equipment to scrap dealers, and several claim the government will take computer equipment back, though no government official I interviewed mentioned such a plan, and based on those interviews, I find it extremely unlikely that such a plan exists.

4.3.3. Organizations Operating in Ghana

Most respondents reported that computer equipment was kept for as long as it was possible before disposal, though, as previously mentioned, one organization is

trying to update regularly computers at the organizations they work. Indeed, several respondents reported that their partners would hold onto equipment, even non-functional equipment for as long as possible. Even non-functioning units can be “cannibalized” for spare parts to help repair other equipment. As noted, the desire to use broken equipment as a source of spare parts is intentionally built into the plans of many organizations.

I interviewed the IT coordinator of the Technical Division of the Ministry of Education. He oversees all IT operations at the country’s technical schools. The ministry regularly gets donated equipment from the global North. They do not enforce minimum standards for this equipment. In our discussion of the computer lifecycle within the school system, he reported that local administrators had a large amount of discretion over disposal at their schools; the ministry was primarily concerned that the accounting was properly handled before disposal. Donated equipment can also be sent directly to schools without going through the ministry, in which case the ministry was not concerned with the accounting. He did say that most schools would simply dispose of the computers, either through the municipal system or by giving them to scrap dealers. They do not auction equipment off, as it is easier to dispose of it than to deal with the hassles of an auction.

At the time I spoke with the IT coordinator, he reported that the ministry was working to establish centers around the country to handle maintenance of the computers throughout the system. Currently, many schools use private dealers to do their computer maintenance. It is to these private dealers that I now turn.

4.4. Used Computer Dealers and Repairers

4.4.1. Summary

The goal was to learn how computer dealers and repairers interacted with organizations receiving computers as donations and how they managed disposal of their own equipment, whether internally generated or on behalf of customers. Again, the question is one of recognition of potentially affected parties. Like the schools, the dealers tend to hoard equipment before giving or selling it to scrap dealers, or disposing of it through the municipal system.

4.4.2. Interview Results

I interviewed employees or owners at eight retail stores in Accra selling used computer parts (six) and/or doing computer repairs (eight). Two interviewees reported doing sales and service for schools, though I did not specifically ask this question, so it is possible that others do as well. One additional shop reported doing training for staff at schools. The sources of equipment for those companies doing sales (as opposed to just repairs) varies, some buy from Ghanaian importers, others directly from importers in the US or Europe. Perhaps most interestingly, two reported that contacts (and even the shop owner) lived abroad and acquired the used equipment.

All reported holding on to broken equipment for as long as possible to use for spare parts. Two reported that they had never thrown equipment away (though one person had been an employee for less than a year). One reported simply throwing useless parts in the trash, the remainder (five) either gave and/or sold used equipment to roaming scrap collectors. Two interviewees noted that the scrap collectors particularly prized monitors and were willing to pay 30,000-40,000 cedis (~\$3-4) each.

It should be apparent at this point that donated equipment is treated no differently from other equipment at the time of disposal and that there are two primary paths of disposal, the first being the municipal waste system to Oblogo and the second roaming scrap collectors carrying waste to Agbogbloshie. I will now describe each of these paths in turn.

4.5. Paths of Disposal

4.5.1. Summary

At the local level, it is important to understand how the government handles waste. This ties in directly with the issues of recognition of e-waste-affected people; the issues here become more explicit. The people affected are not unknown to government officials, as is sometimes the case with donating organizations, but are directly and explicitly addressed by government waste management policies. These policies tie in with participation, because the government excludes people from democratic decision-making, leading to maldistribution.

All officials placed little priority on e-waste as something separate from overall waste concerns, though the officials I interviewed at the EPA expressed surprise and concern at the recycling operations going on at Agbogbloshie (described below). Recent studies have shown that areas surrounding e-waste processing sites have dramatically increased exposure to lead and other heavy metals. It also became apparent that, although waste management capacity in Accra is unevenly distributed, attempts to move to a universal fee-for-service model of waste collection may only exacerbate the disparity, increasing the maldistribution of waste in marginalized populations, such as those in Old Fadama.

The AMA considers the residents of Old Fadama squatters, with no legitimate claim to the land they live on. As such, the AMA has adopted a politics of non-

recognition towards the settlers enable the Korle Lagoon Restoration Project. However, the ultimate legitimacy of the settlers is still in question (Grant, 2006). As a consequence of the policy (which has softened somewhat recently), there seems to be a conscious effort to deny the settlers waste management services. It is possible that to provide them waste services would be a tacit admission of some amount of legitimacy. However, one waste management official claimed the residents were unwilling to pay for it. But the assumption of unwillingness to pay is seemingly counterfactual, because as I show below, residents of Old Fadama sometimes do pay for waste removal. Instead of the government officials basing their beliefs on discussions with the residents of Old Fadama, they seem to be based on the stereotypes of poverty and filth portrayed by the media. This is a clear case of denial of recognition leading to maldistribution of waste hazards. The policy of non-recognition further marginalizes the population by denying them a voice in environmental decision-making.

At the dumpsite in Oblogo, the results are different, but the story is similar. The AMA has taken advantage of the confusion caused by the articulation of traditional and western systems of land tenure to get access to the land in Oblogo without adequate recompense to the community, including failure to provide the promised health clinic and market. Instead of dealing with the community, the AMA deals only with the chief, despite his de-stooling by the people of Oblogo. In this case we have both the denial of participation, and recognition. Participation and recognition are closely intertwined, if the AMA recognized the people of Oblogo as possessing of equal rights of self-determination, as being fully human, they would secure their rights of participation in decision-making, instead they exploit traditional systems to their own ends. It is difficult to consider the chief a legitimate representative of the people when he rarely enters the town, and even then only does so with bodyguards present.

The result of this injustice is, unsurprisingly, increased environmental hazards. Run-off from the dumpsite has destroyed the river's fish stocks, removing an important

source of livelihood for the community. Stagnant leachate has led to increased cases of malaria and other diseases.

4.5.2. Waste Management in Accra

I interviewed officials with the AMA's Waste Management Department (WMD), the Ghana EPA, and the Sanitation Division of the Ministry of Local Government, Rural Development and Environment. These agencies each have different roles and responsibilities for managing waste disposal within Accra. The EPA is responsible for setting environmental standards, such as acceptable lead levels. The Sanitation Division sets policy at the national level, issuing guidelines on sanitation service³ delivery, then monitoring and evaluating service delivery, as well as distributing funds to meet these guidelines to municipalities nationwide. The WMD is responsible for the actual implementation of trash collection services in Accra. The Sanitation Division is developing a new set of policies that emphasize the "Three R's" – Recovery (including Recycling), Reuse, and Reduction. These policies were drafted with public input, particularly from local chiefs. The draft of this plan was not available to the public, but the official I spoke with said that e-waste was not a high priority for the division at this time, though they were aware of the broader issue. The EPA had a similar response; interviewees reported no particular focus on e-waste, and no information on quantities entering the country, though they admitted it was something worth investigating. They were unaware of the e-waste recycling operations at the Agbogbloshie Scrap Market, yet did express concern that such operations were occurring.

Within Accra, it is unclear how much of the city's waste is actually handled by the municipal system. One WMD official I spoke with claimed that 80-90% of the city's trash

³ Sanitation service includes trash disposal as well as public hygienic services such as toilets and showers. The Ministry of Water Resources, Works, and Housing is responsible for sewage and water distribution.

was discarded at the Oblogo site. This is somewhat higher than the numbers claimed by Boadi and Kuitunen (2003; 2005), which would seem to put a cap around 80%.

Municipal waste collection happens through two primary means: door-to-door collection in wealthier neighborhoods and through the use of public containers in less affluent areas. Disposal in public containers is currently free, though door-to-door service must be paid for. Not all areas of town are served by a public container, including Old Fadama. I asked one WMD official why Old Fadama had no container, since some 30,000 people live there; he replied, “If a container is brought they would say, no, they shouldn’t have to pay.” As Boadi (2003) notes, poorer people do have a lower willingness to pay for environmental quality, but this is countered quite easily. Container service is currently free to other residents, and as I show later, residents do demonstrate some willingness to pay for trash services; one resident of Old Fadama said to me about their



**Figure 2: Public trash container and toilets in the La neighborhood
Toilets are to the right**

community's lack of a container, "We are humans and we should get one." This strikes directly at the question of recognition.

Since 1996 the AMA has tried to make waste collection more self-funding by moving to a pay-for-service model using private contractors. This project was initially started by the World Bank (2006). Although the World Bank project has ended, AMA continues the effort, despite often being unable to pay waste contractors. Under a pilot project recently rolled out in one part of the city, access to containers is restricted and residents must pay a private contractor to have trash taken to the container. This project will use smaller equipment such as carts and wheelbarrows to serve the narrow streets where large machinery cannot go.

Trash that is not managed by the AMA is either discarded illegally, usually in open areas and waterways, or is burned (Boadi & Kuitunen, 2003). The AMA does attempt to clean illegal dumps when they can. The official at the Sanitation Division reported that public complaints over the radio were a popular way to draw attention to problem sites. Indeed, I visited one illegal dumpsite in the La Wireless part of town, which several weeks later had been cleaned up by the AMA. Residents near this dumpsite claimed that their assemblyman was corrupt and condoned the illegal dumping. In another informal discussion, one person claimed that her assemblyman was paid to look the other way while waste contractors emptied their trucks in an old quarry.

Normally, waste contractors take the containers to a dumpsite in the village of Oblogo. The dumpsite is not a properly engineered landfill (a distinction that the official at the Sanitation Division took pains to make clear), but simply an abandoned quarry that has been filled with trash. The AMA has for several years planned a properly engineered landfill in Kwabenya, outside Accra, though lack of funds and local opposition have slowed the project; it is not expected to be operational until 2009 at the earliest (Ghanaweb, 2007). The Oblogo dumpsite is simply the latest in the series of dumpsites used by the city. At the time I conducted this research, the Oblogo dumpsite was nearly

full, and a new dumpsite was in preparation a short distance away. That dumpsite was expected to be in use by the end of summer 2007.

4.5.3. Oblogo

The dumpsite at Oblogo looms over the town, a large mountain of trash stands out against the side of the hill. Municipal trash of all sorts has been dumped into an old quarry, now nearly full. A draft map done by the Geological Survey Department of Ghana and the German Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources) show that the Oblogo site sits in what should be a legal exclusion zone and just outside the zone excluded for geological reasons. The dumpsite was created after the EPA's guidelines went into effect and violates any number of other regulations (*Ghana Landfill Guidelines*, 2002). The new dumpsite, slightly up the road from Oblogo, is also in the both exclusion zones (Edifor, 2005). Residents of the village cluster near the river, a couple of hundred meters downhill from the dumpsite, but homes extend up the hillside, some directly abutting the dumpsite. Because there is no separation of wastes in Accra, the dumpsite contains not only e-waste, but organic waste, medical waste, and industrial waste.

Although at this stage, e-waste is just one part of the solid waste stream, the same processes of misrecognition, and lack of participation operate here. The conflict between the property rights system introduced by the British and the traditional land tenure system has enabled the local chief to enrich himself and move out of the area while permitting the AMA to claim procedural justification for locating the dumpsite in Oblogo – even in a location that should be illegal. Promises to the villagers for recompense go unfulfilled.

I interviewed a number of residents of Oblogo over the course of several visits. The dumpsite has had a dramatic effect on the village. Dark black leachate flows from the dumpsite, through the village and into the River Densu. When it rains, the leachate

runoff floods the town, eroding the foundations of houses, and turning the river black. The leachate and the trash carried in it have also contributed to an increase in mosquitoes and consequent cases of malaria. The AMA sprays gutters in the village 2-3 times a month, but several people described having to spend significant sums of money on pesticides to control mosquitoes.

The residents of Oblogo, like other Ga, are fishers. The leachate has destroyed the fish stocks in the river downstream from the dumpsite, having severe effects on people's livelihoods. Where once they could fish for food, they must now buy much of their fish from other fisherman. The fish they do catch often have black flesh and go rotten very quickly.



Figure 3: Leachate runoff in Oblogo
High water carries the trash from the dumpsite when it rains

The WMD and the EPA both reported on a plan to collect leachate in a sump, and spray it back onto the dumpsite. However, the pump for this project has yet to become operational, despite repeated promises. This is not the only promise to the residents of Oblogo that has gone unfulfilled. Before AMA began using the dumpsite, they promised to construct a market and a health clinic for the community members. Both of these have been constructed, however they have yet to be used, and the health clinic has never been staffed. One WMD official said the problem was with the Ministry of Health while another claimed the clinic was nearly complete and would be staffed soon (villagers report that no work has been done on the clinic in two years). A promised public toilet has never appeared.

Several WMD officials I interviewed said that they (the AMA) would deal only with the local chief. However, residents of Oblogo place the blame for many of their problems on the same chief. The litany of complaints against the chief was long; they included subversion of traditional ruling processes through the installation of his sons in advisory positions traditionally held by elders (thus enabling easy agreement to AMA requests – a denial of community participation), embezzlement of funds promised to the community by the AMA for use of the dumpsite, the retaliatory destruction of a community-built toilet for the women, and the illegal sale of community lands (including the land on which the market and health clinic sit).

This is a particularly salient point as it highlights the conflict between the traditional and the western in Ghana. Under the traditional land tenure system (with appropriate allowance for local variation), the chief holds the land in trust for the people and he is responsible for allocating land to those who need it. But under western property rights schemes that have been applied across Ghana, the chief has been able to sell the land, although under the traditional system the land was never truly his to sell (Agbosu, 2000). This has led to widespread confusion and conflicts over land rights across Ghana, overwhelming the government systems charged with managing property

disputes (Blocher, 2006). In the case of Oblogo, it is clear that both the chief and AMA have benefited from the chaos surrounding land tenure.

The chief is clearly unpopular. One villager in the focus group perhaps summed it up best: “fucking stupid chief” – a profanity far stronger in Ghanaian ears than in American or British. Another focus group participant suggested they should just “slaughter” the chief to put an end to the problem. This may not be an entirely idle threat, as the chief reportedly must bring bodyguards when he visits the village. The result has been that the community has attempted to de-stool the chief, first through traditional means and when that failed (villagers assert bribery), the villagers sued in the national courts, though the case has been tied up in that system for over a year. A ruling from the High Court was expected in the latter half of 2007. (The parallel court systems also reflect the conflict between the western and the traditional.) This subversion of community rule, even though that rule is not expressed through western-style democracy, is a clear denial of participation, and in a manner that would place it directly in conflict with the Rawls’s right to “political liberties,” one of his five foundational “basic rights” (Freeman, 2007).

4.5.3.1. Scavengers

At the dumpsite, some 70 scavengers operate in two shifts. Unlike roaming scrap collectors who tend to live in or near Old Fadama, the scavengers commute from all around the city. One came from Madina each day, a commute of two to three hours each way. The scavengers are allowed to operate at the dumpsite, but are otherwise given little protection by the WMD. When a container of trash arrives, the scavengers swarm over it and attack it with a piece of rebar, shaped into a hook. They pull through the trash looking for valuable materials, particularly plastics and scrap metal. They break

apart the cathode-ray tubes (CRTs) from monitors for the copper, and other electronics are stripped down and the wire collected.

WMD officials largely allow the scavengers to keep to themselves. The scavengers complained that the AMA does little to help them, and that malaria is rampant. The WND officials say they that do offer safety suggestions, such as wearing boots and gloves, but do not provide them. When dumping hazardous materials, such as medical or industrial waste, they at least take it further away from where the scavengers operate. While I was there, one truckload industrial waste was dumped some 30 meters from where we were standing. The scavengers avoided it, but otherwise it was not treated specially. The WMD official with us said it was asbestos.

Each scavenger collects his own material, which is then weighed and put into a communal pile. When the pile is sold, the money is divided according to the volume each person contributed. Typical daily earnings per person are 50-60,000 cedis (~\$5.50-6.50), though variation between 40-80,000 cedis (~\$4.25-\$8.50) was reported. The scavengers are paid for materials as follows (the mixed units are those that were reported):

- Aluminum, copper, brass = 4,000 cedis per pound
- Steel = 2,000 cedis per kilogram
- Plastic = 1,500 cedis per kilogram

4.5.4. The Agbogbloshie Scrap Market

The second and most common path that electronic waste takes through Accra is collection by roaming scrap collectors who carry it to the Agbogbloshie Scrap Market and sell it to the scrap dealers who live and work there. The Scrap Market sits next to Old Fadama; many of the people working at the market also live in Old Fadama. Here we see most clearly how maldistribution, misrecognition, and lack of participation intertwine. The residents of Old Fadama are widely vilified in the media; the settlement is popularly known as “Sodom and Gomorrah.” The majority of its

residents are immigrants from the Muslim north of the country. Discrimination against its residents is common, from epithets of “*zongo bola*”⁴ to “blackheads,” and “invaders.” This kind of out-group discrimination shows why Pellow’s (2007) argument for treating racial discrimination as a driving force behind environmental injustice is too narrow. Linguistic de-humanization, the type of misrecognition seen here, is widespread in human conflicts. This dehumanization also feeds into other types of misrecognition and denial of participation (Schlosberg, 2007).

The AMA sees the residents of Old Fadama as illegitimate squatters and eviction is continually threatened. Although the Government of Ghana claims the land, the Ga Traditional Council also asserts a right to use the land if the Government does not develop the lagoon. (COHRE, 2004; Grant, 2006). Residents oppose eviction because they fear loss of community and difficult commutes if they are relocated. They would much prefer to remain where they are, but with improved services. However, the AMA is not only unwilling to provide service, it actively refuses to provide significant sanitation services (misrecognition), and no assemblyman will meet with the elders (lack of participation). As a result, sanitation is poor, trash is indiscriminately disposed of, and hazardous materials from e-waste are handled in a manner that exposes all residents of Old Fadama to unnecessary risks.

Curiously, in a 2001 study of Environmental Health in Accra (Songsore et al., 2005), the entire Old Fadama/Agbogbloshie was left out of the survey, though the surrounding areas all show much higher environmental health burdens such as diarrhea, dysentery, and upper respiratory infections (Boadi, 2004; Songsore et al., 2005). In Old Fadama, the burden is likely even higher than nearby areas. The processing of electronic waste has been shown to present severe health risks to both e-waste workers and surrounding

⁴ The term “*zongo*” comes from Hausa and is used to refer to the “strangers’ quarters” within a city. In Ghana, it refers to any spatial amalgamation of Muslims; typically these are migrants from the northern parts of the country (Pellow, 2002). In recent years, the term has also been used to refer to any slum, but especially those with migrants from the north (Demanya, 2007). “*Bola*” is the Twi word for “trash.”

areas. Circuit board disassemblers ingest up to 50 times the “safe” levels of lead, and people in areas surrounding e-waste facilities are estimated to have exposures of up to 10 times the “safe” levels for adults. For children in the same areas, the risk is eight times higher than that for adults (Leung et al., 2008).

4.5.4.1. Roaming Scrap Collectors

My interviews revealed that the scrap collectors were overwhelmingly teenagers, nearly all between the ages of 14 and 18, though one reported his age as 24. All of the scrap collectors I interviewed came from the Northern Region, though they did say there were a few Nigerians working among them. At the time I conducted this research, the school year had just ended; many of the collectors had only been in Accra for a few weeks, or even days; they intend to only work for the summer, then return home.



Figure 4: School children passing through the “annex” scrap market to Old Fadama

They live near the scrap market, either renting a bed in Old Fadama, Konkomba Market, or another nearby area. Most of them have done this work for multiple summers, usually for one to three years prior to this one, though one reported being in his seventh year. They keep their money in a *susu*⁵, then send their earnings to their parents. Payment of school fees was a common goal, as was purchase of a bicycle or a television for the family. Although they sometimes lose money on the day's business, they often earn 45-60,000 cedis (~\$5-6.50) each day.

The scrap collectors rent handcarts (*trucks* in Ghanaian English) at the scrap market and walk around the Accra area collecting scraps and bring them back to the



**Figure 5: Scrap collector preparing copper wire for burning
Note the fire in the top left. Old Fadama is in the background.**

⁵ *Sususu* are a traditional savings scheme in Ghana. Deposits are taken to the *susu*, which holds the money for a fee – typically one to two days' wages per month.

scrap market. They often obtain scraps by inquiring at local businesses, but also by going through containers. It is common for them to walk significant distances. I spoke to people who, that day, had walked to and returned from Weija (some 20km each way from the market) or to Madina (25km each way.) Because they do not follow direct paths (that would cut down on the opportunities to find new scrap), the actual distance traveled is probably somewhat greater than that.

As they wander the city, they trade with other scrap collectors at points around the city, Achimota Overhead was a popular one. I visited the overhead a couple of times and interviewed collectors there. There was a discarded scraps and burned waste underneath the overpass, and surrounding embankments, in particular a number of CRTs with the copper removed. The tubes themselves are not considered valuable; I



Figure 6: Disassembling CRTs at Agbogbloshie Scrap Market

observed tubes with the copper removed not only here, but discarded at various places around the city.

The collectors take scraps ranging from car parts to household electronics – anything with metal or plastics. CRTs are particularly prized for the large amount of copper in the yoke. They will sometimes pay for scrap, I heard ranges from 15-50,000 cedis (~\$1.50-5.50) for a CRT depending on the size and 20-40,000 cedis (~\$2.25-4.25)



Figure 7: Discarded CRTs at the Agbogbloshe Scrap Market

for a system unit. When sold, they earn:

- Copper = 20,000 cedis (~\$2.25) per pound⁶
- Aluminum = 5,000 (~\$0.50) cedis per pound
- Iron/steel = 500-1,000 cedis (~\$0.05-0.09) per kilogram depending on type
- Brass = 800 cedis (~\$0.08) per pound

4.5.4.2. Scrap Dealers

Scrap that is not disassembled en route (such as at Achimota Overhead) is broken down at the scrap market. The main scrap market sits on the northern side of the Odaw River, and covers some 20,000 m². According to the head of the Scrap Dealers' Association, the market has operated for ten years. The Association itself has existed



Figure 8: Food merchants in front of the Agbogbloshie Scrap Market

⁶ The mixed measurement units in this list are those given by the scrap collectors

for about eight years. Since early 2007, the Association has been paying rent of 500,000 cedis (~\$54) monthly to the Government of Ghana for the use of the land on which the market sits. A smaller “annex” scrap market lies on the other side of Old Fadama, some 700m further south along the Abossey-Okai road.

Trash litters the ground of the scrap market, most noticeably broken computer equipment, particularly boards and other plastic parts. Monitor casings are popular as makeshift seats. Broken glass for CRTs is spread around the outside edge of the markets. Near the road, women are cooking food for sale and children pass through the smaller market to the south on their way from school to their home in Old Fadama.

The Scrap Dealers’ Association decides who can work as a dealer in the market, and all of the scrap dealers pay dues. The Association also disciplines members who violate its rules, perhaps by fighting or stealing. At the scrap market, the collectors disassemble the equipment they have gathered and sell it to the scrap dealers who operate there.

I spoke with two different dealers who deal specifically in computer parts. They buy components, such as CD-ROM drives, or motherboards and cases. If a motherboard, in particular, is not working, they will remove and test the various components (chips, capacitors, etc.). They then keep these and sell them to people who come to them looking for spare parts or young people hoping to assemble a working computer from the spare parts.

However, most of the scrap is disassembled into its parts. Copper is collected, then taken out to a spot a few dozen meters behind the market, where it is burned to remove non-copper materials (such as wire jackets and insulation). It is there that other non-valuable parts are burned. The smoke from the burning generally blows into the scrap market, or into Old Fadama, giving the whole area a grey, dingy cast even on sunny days.

In asking about health concerns, most were concerned with injuries directly related to the scrap: cuts and scrapes, particularly from scrap, fingers broken by hammers during disassembly, and burns from the hot metals. They also reported having trouble registering for the National Health Insurance Scheme. Officials insulted them, calling them “blackheads”, and assuming they were illiterate, tried to overcharge them.

I asked a group of eight scrap collectors about the smoke, what was burned, what good things come from the smoke, and what bad things. These results are shown in Table 4. One participant commented that some people smoke cigarettes because they believe it neutralizes the negative effects of the smoke.

The Scrap Dealers’ Association asserts no control over the burning, as the people doing the burning are not members of the Association, and the burn site is outside of the scrap market, though at one point the collectors had been asked to move the burning further away from the market. However, the Association’s head did say that the scrap dealers also burned trash. Despite the rent the Association now pays, the market gets no municipal trash collection. He said that maybe the city should pay them, given the trash removal services they provide.

Table 4: Scrap collectors’ understanding of burnt scrap

Things which are burned	Good things from burning	Bad things from burning
Monitors (yokes in particular)	They get paid to burn for other people	Burning causes sickness
Copper waste	Removes the plastic	Physical burns
Armatures	Income for yourself	Can hurt your heart
Aluminum		Headaches
Refrigerator cores		Cancer
Refrigerator motors		Hypertension
Air conditioner tanks		

The scrap dealers stockpile valuable metals until there is enough to fill a container, at which point they call an exporter who brings an empty container. Dealers typically get 1.6-1.8 million cedis (~\$172-\$194) per ton for steel, depending on the quality. Most steel stays in the country, while copper and aluminum are sent abroad. See the discussion of the CEPS data below for more detail.

4.5.5. Old Fadama

In Old Fadama, I conducted a community mapping exercise followed by a focus group discussion. The goal was to learn what exposure the residents had to e-waste and other dangers, and how much say they had in environmental decision-making.

The mapping exercise showed that the participants defined their community by the two waterways to the north and south and the main Abossey-Okai Road. The favorite



Figure 9: Korle Lagoon between Old Fadama and the “annex” scrap market

place for both men and women was the mosque. They hated the lagoon, associating it with foul smells and mosquitoes. The public toilets were defined both as a favorite place and a least favorite place; favorite because of the role in hygiene (one man said, “Without a toilet, we couldn’t shit. We’d have to shit in our campus.”); least favorite because of the poor quality of the construction, the foul odors, and the health risks from the poor sanitation. Only one woman made a comment on the places they disliked. She quietly whispered, “everywhere.” This is not surprising. Women head porters, known as *kayayei*, are typically short term residents from the northern areas of Ghana; they are often young and uneducated, and often face sexual assault and rape in the shanty-towns (Awumbila, 2007; Opare, 2003).

Municipal trash services in Old Fadama are non-existent. Residents dispose of trash either by carrying it to a container, if they are going in the direction where one is, or they sometimes pay 1-2,000 cedis (~\$0.09-0.18) to have someone take the trash away. Otherwise, they burn trash or throw it into the lagoon. When discussing the scrap market, participants noted that relations with the scrap dealers were good, but the burning was bothersome. At the same time, they recognize that there is little alternative to the practice or the location of the burning. They said that children pass through and play in the market, and will often play with materials they find there.

When the AMA organizes citywide clean up campaigns, residents have participated, organizing community members to pick up trash throughout the community and burning it. Trash is often removed to the southern scrap market (the closest one to where we had the discussion) before burning. Nonetheless, relationships with the AMA are not good.

As discussed in the previous chapter, the AMA has several times tried to clear Old Fadama of its residents; the idea of relocation was very unpopular with the focus group. They felt the proposed relocation site was too far away from their work and they valued the community created at the current site. They much preferred that conditions

be improved at the current location. Fire was a major concern given the tightly packed wooden structures that make up Old Fadma. This fear is not unfounded, as fires have destroyed dozens or hundreds of residences in the past (Grant, 2006). The AMA collects business taxes from the residents, though usually only from people working on or near the main road. The head porters pay 1,000 (~\$0.09) cedis every day; one scrap dealer reported paying 200,000 cedis (~\$21.50) a month.

I asked whether the community had approached the AMA to ask for a container. They had not and they felt they should not have to because, as one man commented, “we are humans and we should get one.” They complained that they had trouble expressing concerns to the AMA. Whenever a group of community leaders goes to visit their assemblyman, he is always out or unable to meet with them at that time. The only time they have seen anyone was a single candidate who came through soliciting votes and promising a trash container. He lost.

Although they lack trash service, there are pay showers and toilets in the community. The residents were unsure who runs them; some thought the AMA while others thought they were privately run. The showers have the only running water in the community; clean water comes from hawkers, who charge 700-1,000 cedis (\$0.07-0.10) a bucket. If one is willing to walk some distance, a bucket of water can be had for 300-500 cedis (\$0.03-\$0.05).

4.6. CEPS Data

The CEPS data shows a growing trend in both computer equipment imports and scrap metal exports. Used computer⁷ imports make up the bulk (77%) of the computer equipment imported since January 2003: 19,823,512 kg of used vs. 5,862,561 kg of new computers. The bulk of used equipment comes from Europe (57%) followed by the United States (26%). Scrap metal exports go largely to China (24%), Germany (16%),

⁷ As discussed in the previous chapter, used computers are those in which the word “used” appears in the description field of the shipment. New computer equipment is considered to be everything else.

and India (11%). The overwhelmingly largest recipient of copper scrap⁸ is China (67%), the next closest is Germany with a mere 8.9%, just less than the remainder of Asia. This data is summarized in Figures 10 and 11. Detailed tables appear in Appendix B.

A time series analysis by loess decomposition was done on the scrap export data. The decomposition separates seasonal variation from the overall trend in the data, thus allowing for separate analysis. A Shapiro-Wilks test indicates that the residuals of the decomposition were normally distributed ($p=0.07$). The decomposition shows an overall increasing trend in scrap exports. The seasonal component shows peaks in May and June of each year, but a sharp fall off in July and August. This may be explainable by the arrival of scrap collectors from the northern parts of the country causing a surge in output, followed by a decrease as the supply of accumulated scrap decreases, but other peaks do not lend themselves to easy interpretation. A graph of the results of the time series analysis appears in Figure 12.

4.6.1. Conclusion

In this chapter, I presented the results of my research and how the results link to the research questions presented in the previous chapter. I began to outline how the theoretical frameworks I use link to the results. In the next chapter, I will strengthen this link and discuss the implications of the research both practical and theoretical.

⁸ Shipments of copper are those in which the word “copper” appears in the description field of the shipment. This sometimes includes mixed scrap metal lots, such as those with both brass and copper.

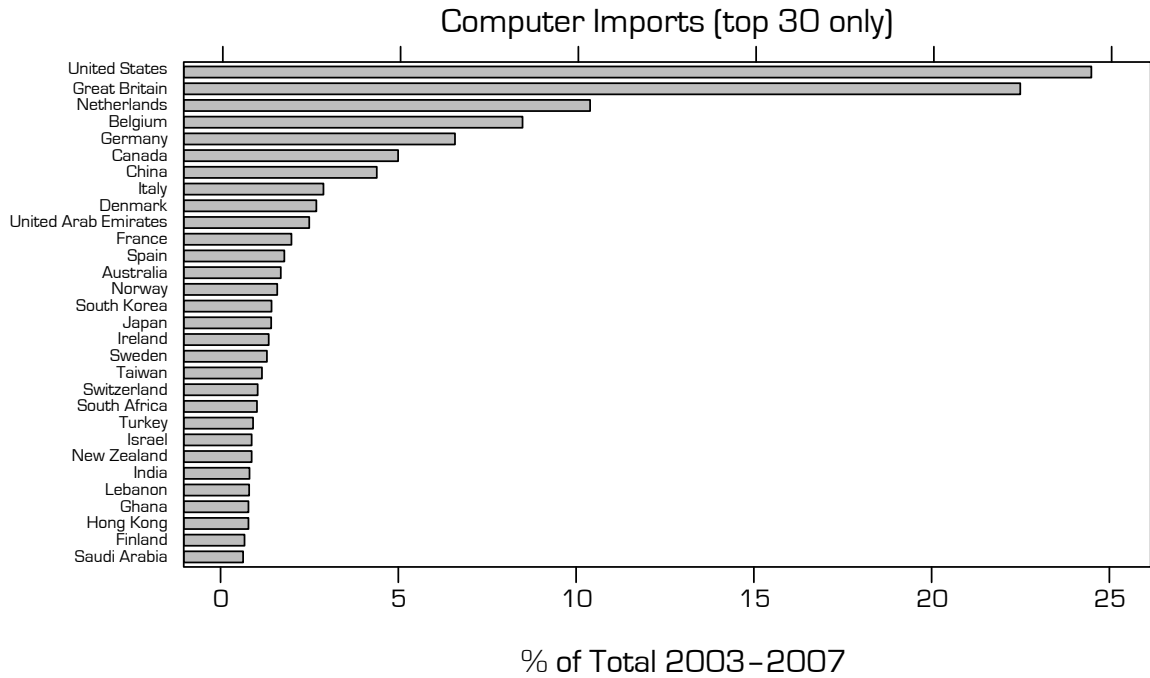


Figure 10: Sources of used computer imports

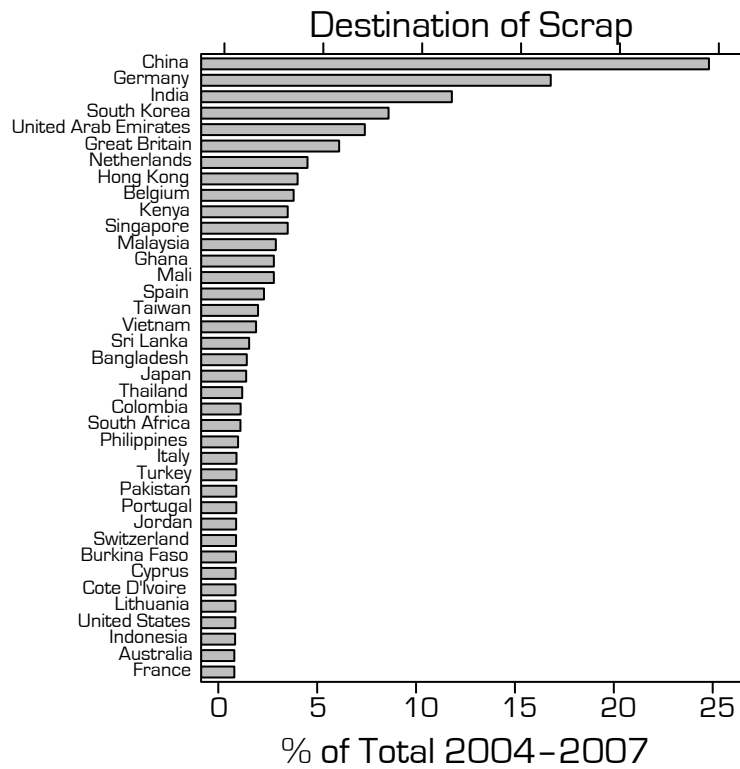


Figure 11: Destinations of scrap metal exports

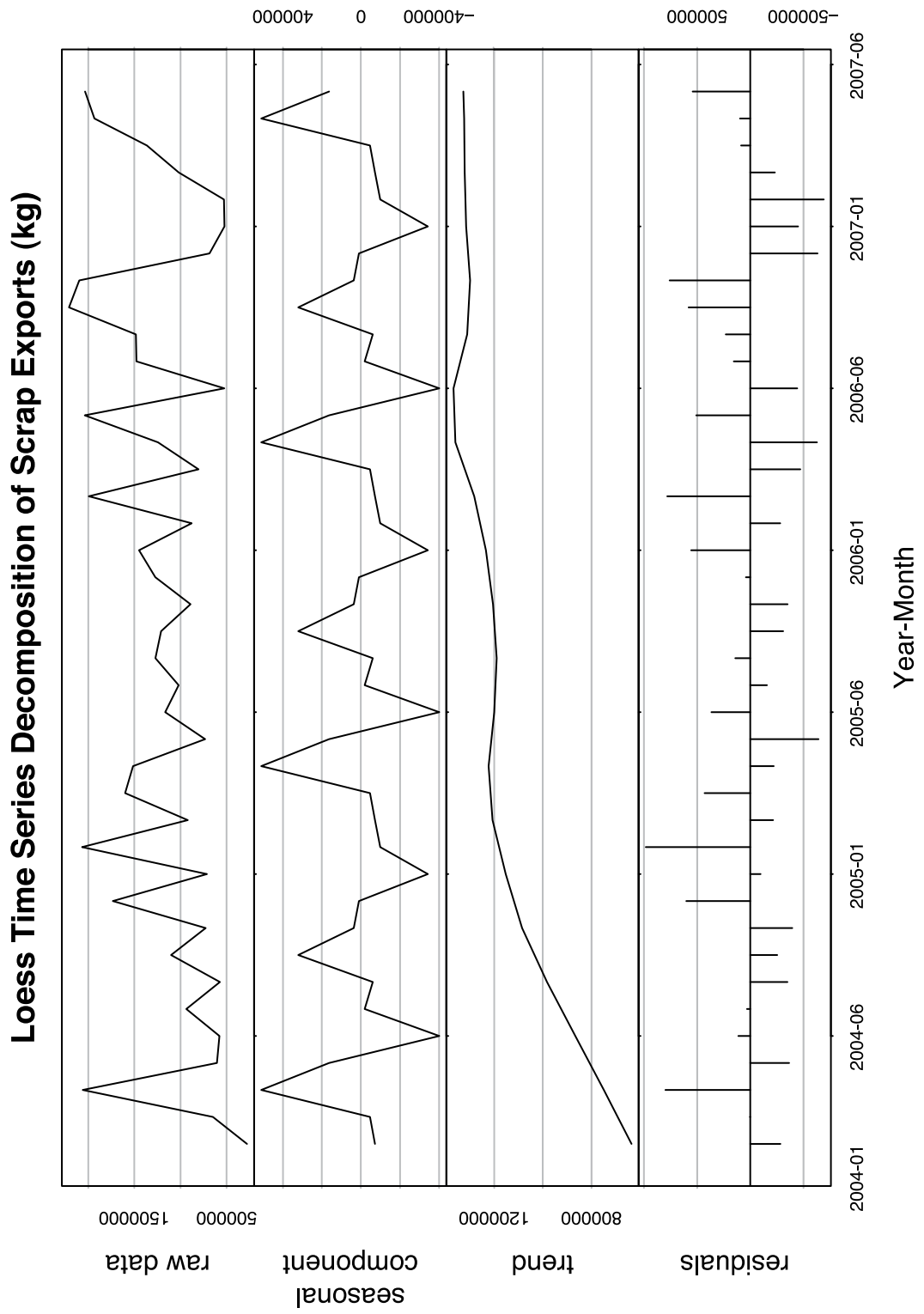


Figure 12: Time series analysis of scrap exports

Chapter 5: Discussion

5.1. Overview

In the previous chapter, I presented the results of my research. I stepped through the lifecycle of donated computers from the time they are collected by donors to the time they are discarded. In this chapter, I discuss the implications of those results.

While many charitable organizations are aware of the concerns associated with e-waste and attempt to educate recipients, only one of the organizations I interviewed had a recycling program. The most common recipients of donated computers in Ghana are public and private schools. While it should be expected for private schools to have a variety of disposal methods, it is notable that even schools run by the Ministry of Education are largely autonomous in managing and disposing of computer equipment. All schools typically discard equipment in the municipal waste stream or by giving it to scrap collectors. These schools also often rely on used equipment dealers and repair shops, which dispose of computer equipment similarly.

Each of these waste streams presents differing facts, but similar results. At the municipal dumpsite in the village of Oblogo, the AMA has exploited the upheaval created by the articulation of traditional and western forms of governance to deny participation in environmental decision-making processes to Oblogo's residents. The AMA has similarly worked to deny the residents of Old Fadama environmental and general democratic participation. This denial is intimately tied in with the out-group discrimination reported by the residents, as most of the residents of Old Fadama are poor, Muslim migrants. Ghanaian media regularly vilifies the residents as well, referring to the community not as "Old Fadama" but as "Sodom and Gomorrah." As a consequence, it becomes acceptable for its residents to perform some of the most dangerous work (including working in the scrap market), to have little housing security,

and to be exposed to much higher risks from electronic and other waste than other residents of Accra.

In this study, I used a political ecology framework and built on recent work in environmental justice theory. Political ecology has long had a multi-scalar perspective and a strong emphasis on the wider contexts in which environmental conflicts play out. However, a traditionally rigid theoretical basis in Marxism can too often lead political ecologists to overly determined explanations. In contrast, the environmental justice theory I use is less structural, incorporating Pellow's (2007) argument for a theory that explicitly accounts for the dynamics of race and culture, as well as economic and political concerns.

5.2. Interpretation

In these results, I have shown how injustice is created when people lack the three factors described by environmental justice theorists: participation, recognition, and equitable distribution. Just as importantly, I have begun to show how the processes creating these factors operate across scales, from global governance to local politics.

The manufacturing focus of global organizations addressing e-waste, such as the United Nation's StEP program, ignores the very real social and economic factors that create the exposures to e-waste dangers. While the Basel Convention makes intentional export of electronic waste illegal, there are strong economic drivers in both the North and the South that will ensure the continued flow of electronics into the South whether illegal or legal. The portion of this flow I focus on, donated computer equipment, is not only legal under the Basel Convention, it is encouraged by the United Nations as a way to reduce overall waste through reuse. But the short lifespan of these computers (Toxics Link, 2003) has unintended consequences which should be addressed. This type of reuse simply relocates the problem to countries with little capacity to manage the toxics contained in the equipment.

This flow of used equipment lacks any method of remediation and thus contains an implicit maldistribution of harm and misrecognition of those affected by the waste. Simply pointing to the economic benefits of access to technology or to the overall reduction in future waste generation is insufficient. As Schlosberg (2007) makes clear, “[m]erely because the distribution is caused by, for example, market forces rather than targeting of minorities does not mean that the overall process is just” (p. 59). As the volume of e-waste grows, it will continue to trickle down to the marginalized members of society. As I have shown, it is not at all uncommon for computer equipment sent to the global South to be eight to ten years old, and the current slow pace of producing more environmentally sound manufacturing improvements ensures that this flow of toxic waste will continue for years or decades to come.

The global actors in the electronics industry and the government entities must recognize that, even in cases of beneficial reuse, there are environmental and social costs. Organizations that focus on the donation of computers to the global South have begun this process, they are broadly aware of the problems of e-waste. They take efforts to minimize the amount of waste generated by ensuring a uniformity of configuration, leading to a longer life for the computers. This is admirable and necessary, but insufficient. Most of these organizations allow the resale of some of the donated equipment to provide operating funds for the remainder. One of the organizations I interviewed has shown that a safe e-waste recycling program can be run through these funds at a cost of \$5, or 5-10% of the typical cost of bringing a computer to Africa. However, these costs may be significantly higher in rural areas, as noted by one interviewee. Even if these organizations universally implemented these programs, smaller charitable organizations lack the knowledge to do so, to say nothing of the non-charitable flows of electronics. None of this is to argue that computer donations should be stopped, but it does show that better management of the e-waste stream is possible. Rather than working on their

own, smaller organizations could co-operate with larger ones, who have more expertise in acquiring, delivering, maintaining, and disposing of computer equipment.

In Accra, discarded electronics flow through two waste streams. Each stream provides an example of both the multi-scalar processes in effect and the tripartite factors in environmental injustices. In contrast with Njeru (2006), who reports indiscriminate dumping of municipal waste by waste contractors in Nairobi, waste management in Accra is relatively effective, at least where the AMA chooses to provide services. One of the more surprising findings was not what was there, but what was not. I had expected to find outright dumping of e-waste, as had been reported in Nigeria. That does not seem to be the case in Accra. On the contrary, the only obviously dumped e-waste I found was CRTs. Being bulky and heavy, these tubes were likely collected by the scrap collectors, had the copper removed, and were then discarded. Even with relatively effective formal and informal waste management, it does not mean that the ultimate disposal is just. The dumpsite in Oblogo and its consequent pollution have destroyed both the livelihoods and the environment of the residents – a clear case of environmental injustice. The AMA has exploited the articulation between western and traditional forms of land tenure and local governance to achieve its ends. The residents of Oblogo have been excluded from participation in environmental decision-making. The AMA continues to deal exclusively with the corrupt chief, who no longer consults community members, and indeed no longer has the community's support, as evidenced by the vote to de-stool him. This infringes the “basic liberty” of political participation described by Rawls (Freeman, 2007), and the participation in environmental decision-making argued by Schlosberg (2007).

In the second stream, that which leads to the Agbogloboshie Scrap Market, a conundrum appears. Scrap collectors collect and carry scrap metal to the market to sell to the dealers; both groups live in or near the market. This is markedly different from the usual conceptions of environmental justice in the global North, which typically

see environmental injustice solely as an outside force upon a community, rather than communities participating in the injustice from which they suffers. As we can see in Accra, there may be other of factors at work which lead to such participation. For instance, community members may be ignorant of e-waste dangers or simply need income to support basic needs, such as education. I believe, however, that looking through the paired lenses of environmental justice and political ecology allows us to see multi-scalar factors at work that are more than ignorance or economics, such as or media discourses about one particular community or perception of charity and reuse as being solely beneficial activities.

There is a common assumption at many levels that giving waste to scrap dealers is a safe means of disposal. For instance, over a third of the plans submitted to the WCE proposed this method of disposal, and the WCE's board accepted each one. Ghana's EPA was unaware of the e-waste processing going on at the scrap market. Yet, the processing of e-waste has significant hazards and adversely affects the most marginalized people in Accra.

The scrap collectors and dealers themselves are largely unaware of the hazards from e-waste, as evidence by their stated concerns of the health effects from smoke. The Scrap Dealers' Association refuses to take responsibility for the burning that occurs just outside their market. Although the dealers profess to dislike the smoke, they also support the burning by requiring that all non-metal materials be removed. Non-saleable material is also discarded on the nearby grounds or burned, at least in part because the scrap market also lacks trash services from the AMA. For the scrap collectors, the hazards are compounded by their youth; lead exposure in developing brains (those under twenty years old) can lead to learning disabilities and even violent behavior (Reyes, 2007). The children of Old Fadama are often exposed to these hazards as well. There is, of course, the smoke, but parents also reported that their children sometimes play with materials

discarded in the market. Particularly worrisome for children is the lead-infused glass from CRTs.

As previously quoted, Schlosberg (2005) writes, “environmental justice activists often see their identities devalued and make a direct connection between the defense of their communities and the demand for respect” (p. 101). Although there is not an environmental justice *movement* in Old Fadama, exactly this phenomenon is occurring⁸. These primarily Muslim immigrants from the northern part of Ghana are denied recognition by the AMA, in the popular media, and they report experiencing discrimination; they describe being called “blackheads” or “*zongo bola*.” Both are examples of misrecognition through the devaluation of identity. Owing to their squatter status, they are often threatened with eviction by the AMA, which denies sanitation services as a tool against Old Fadama’s residents. This seemingly intentional denial of sanitation services is also a case of misrecognition. It cannot be better summed up than in the words of one resident on why they had not requested a trash container from the AMA: “We are humans and we should get one.” The situation is compounded by the refusal of elected officials to meet with representatives of the residents. As a result, Old Fadama’s residents are disproportionately exposed to industrial hazards, garbage, sewage, flooding, fire, and the smoke from burning electronics in the neighboring scrap markets (which also does not receive trash services, despite paying rent to the AMA).

Political ecology has made great strides in increasing our understanding of social and ecological marginalization. I have attempted to adopt its broad, crosscutting, and multi-scalar perspective in this work. However, the results I have found are not solely explainable by traditional political ecological reasoning.

These dynamics of maldistribution, denial of participation, and lack of recognition are part and parcel of the uneven power relations that political ecologists regularly describe. However, political ecologists are wont to describe these power relations in

⁸ Although Grant (2006) describes how residents have formed organizations to agitate for community rights, this is not a specifically environmental justice movement.

terms of the interests of the actors. Yet, in some cases, such as that of Old Fadama, the powerful, such as the AMA have little in the way of interests in Old Fadama⁹. The misrecognition shown there cannot be reduced to a question of the simple self-interest of the powerful leading them to exclude or marginalize less powerful actors. Human motivations can be more complex than that, perhaps having no rational basis; our “ancestral shadow” motivates all of us in ways that are not necessarily conscious. “Knowing who is kin, knowing who is in our social group, has a deep importance to a species like ours. We construct this knowledge by categorizing others as ‘us’ or ‘them.’ [...] We have an evolved capacity to see our group as superior to all others and even to be reluctant to recognize members of other groups as deserving of equal respect” (Waller, 2002, pp. 153-154). It is a small step from lacking of respect to denial of equal human rights. Whether the denial manifests by calling the other “cockroaches” as happened in Rwanda in the run up to the genocide there, or naming the community “Sodom and Gomorrah” the us-versus-them dynamic is the same, only the magnitude differs.

The powerful may be able to act more decisively, but out-group discrimination and the consequent denial of recognition may be widespread through the populace, which mutes opposition to the actions of the powerful. It is important to consider these and other factors. Power alone cannot explain why one weak minority community is chosen over another to receive a landfill or incinerator.

Viewing injustice through the lens of misrecognition, lack of participation and maldistribution enables an examination of injustice that incorporates considerations of power or political economy without being overly deterministic. Instead of emphasizing factors such as power or class relations under capitalism, starting from this lens allows us to view a myriad of human motivations and actions without assuming *a priori* what

⁹ However, there are some interests. The Korle Lagoon Restoration Project has gotten millions of dollars in grants from wealthy countries, and it could be argued that the squatters at Old Fadama make it more difficult to attract more funding (Grant, 2006). It is also true that the AMA had fought against the squatters before the project was created.

determines those actions. Economics and power may be an ultimate cause of injustice, a proximate cause, or it may not figure in at all.

People donating equipment to schools in Ghana or working to reduce toxics do not do so out of malice or advance of economic self-interest – quite the opposite. The invisibility of the outcomes of their actions nonetheless contributes to the injustice. There is no obvious economic justification for the AMA's anti-squatter programs, except that the squatters are out of place migrants (from an ethnic and religious minority, no less). The residents of Oblogo had the dual misfortunes of having a corrupt chief and living near a large hole in the ground. These factors nonetheless play out in ways that are familiar to political ecologists, such as the use of environmental discourses to justify slum clearance, as in Old Fadama, or exploiting power dynamics and the tensions between the traditional and the western as in Oblogo. By focusing on the intertwined processes of maldistribution, lack of participation, and misrecognition, political ecologists can both demonstrate injustice and explain how it occurs while avoiding the pitfalls of question-begging research.

Of course, no explanation is simple, and the one I have outlined here is undoubtedly incomplete. I reflect frequently on my potential for confirmation bias and fear falling victim to question-begging research. In that spirit, I will highlight some conflicting arguments, and potential future paths of exploration.

Although I have emphasized that the AMA does not provide trash services, it seems to provide some public toilets to the residents of Old Fadama. While I do not feel this undermines my argument, it does raise some interesting questions as to the finer contours of participation and recognition. A potentially fruitful pursuit would be to critically examine the role of the World Bank and the commoditization of trash collection in Accra. Along the same lines, an investigation of the environmental discourses surrounding the Korle Lagoon Restoration Project and its international supporters would be potentially illuminating.

The internal dynamics at Old Fadama are worth exploring, in particular, women face unique challenges. In my research, language and cultural issues presented a significant barrier to hearing their voices. Given these women's closer interaction with children, they would provide valuable information about children's exposure to environmental risks. The squatter settlement at Old Fadama is by no means the only shantytown nor the only predominantly Muslim community in Accra. Much could be gained by studying relations with the AMA and how sanitation services are or are not provided in these communities, particularly Nima or Sabon Zongo.

A more in depth exploration of the Agbogbloshie Scrap Market would provide valuable and perhaps contrasting insights to those presented here. The AMA relocated the wholesale food markets to Agbogbloshie/Old Fadama in the early nineties, and auto-repair shops grew to service the market's trucks (Grant, 2006). The scrap market may be an outgrowth of that enterprise, which raises the questions of how the scrap market came to be dominated by immigrants from the northern parts of the country and what role social networks play in the short-term migration of youth to work as scrap collectors. The Scrap Dealers' Association has successfully negotiated with the AMA in the past to secure access to the land the scrap market occupies. Their insights might point the direction for resolving both the waste and land tenure disagreements surrounding the remainder of Old Fadama.

In Oblogo, the WMD also (irregularly and seemingly ineffectively) sprays pesticides to control mosquitoes, so there is at least a nominal attempt at recompense. The political relationships within and around the village of Oblogo are likely far more complicated than I uncovered in my limited time.

Alas, time is always limited, and all research must conclude. In this chapter, I have given an overview of my research, discussed some of its implications, and given possible suggestions for future work. In the next chapter, I will provide some final remarks then this thesis, too, will come to an end.

Chapter 6: Conclusion

In this thesis, I have explored the multi-scalar nature of the production of environmental injustice. Using a case-study in Accra, Ghana, I showed how the disposal of e-waste can be well understood using recent theoretical advances in environmental justice that emphasize maldistribution, misrecognition, and lack of environmental decision making power as key contributing factors to the creation of environmental injustices. Simply understanding how environmental injustices are generated is not enough. The understanding of injustice must be intimately tied with the goal of alleviating injustice. My research has, sadly, not addressed this goal. However, I believe it fruitful to outline how future research on the alleviation of injustice may take place within the theoretical framework I have used in this research.

If environmental injustice is created through intertwined maldistribution, lack of participation, and misrecognition, then one must address each of these to alleviate injustice. Because these are not only intertwined but mutually reinforcing, it would be reasonable to assume that improving one factor could help to improve the others. I believe that the tools of participatory researchers provide one possible avenue of redress as well as a further test of the theory used here.

Using the example of Old Fadama, future research could engage community members in creating a community waste management plan. By creating their own plan, they could increase their participation in environmental decision-making and simultaneously address the maldistribution of environmental “bads.” Possible tools include focus groups and participatory mapping exercises, which have already been used successfully in other waste management contexts (Glöckner et al., 2004). Other tools, such as participatory video and photovoice can be used to both transform residents’ understanding of their community and the understanding of their community by outsiders (McIntyre, 2003), consequently increasing the recognition of

residents within the broader social context. If this theory of environmental justice is correct, then attempting to simultaneously clean up waste, increase recognition, and enable participation in environmental decision-making should decrease or eliminate environmental injustice in a mutually reinforcing way. Such research could have profound implications for environmental injustices everywhere.

While I have argued that donating computer equipment can, ironically, contribute to environmental injustice, I also see great promise in closing the “digital divide.” In my own life, I have volunteered with organizations bringing computer equipment to the global South. I believe strongly in the transformative and democratizing potential of unfettered access to the Internet and wish to see it universally available at the lowest possible cost. However, as I have argued, one must have a holistic, multi-scalar view of the charitable work they contribute to. In Accra, this failure to think holistically has combined with other social and economic processes to create a pattern of environmental injustice in one of the most marginalized communities. While some charitable organizations make an effort to address the effects of e-waste, they are also limited in their abilities by political and economic forces operating at multiple scales. Addressing environmental injustice will require efforts at multiple scales in industry, government, media, charitable organizations, and regular citizens in the South and the North, all of whom need to recognize the role they play in creating injustice. It is a goal every bit as important as closing the “digital divide.”

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Appendix A: Research Instruments

A.1. Semi-structured interviews with donor organizations

Research Questions:

1. Where do donated computers come from?
2. Is there any awareness of the issue outside the community and is the issue being meaningfully addressed?

Goal: Learn how organizations donating computers collect and distribute computers. Understand their role in supporting organizations that receive computers, and how e-waste is handled, both in the home country and the recipient country.

Participants: Representatives of organizations donating computers, emphasis on those that have donated computers to Ghana.

Estimated length: 30 minutes

Questions:

1. Where do you get your computers?
 - a. What do you do with parts you can't use?
2. To whom do you send them?
 - a. Do you send any to Ghana?
 - i. What organizations?
 - b. Do you provide follow-up support to the organizations, whether software or hardware
 - i. What about spare parts?
 - ii. Are provisions made for environments in which the computers are placed, such as environments with unreliable power?
3. Do you have provisions for managing computers after end-of-life in recipient countries?
 - a. Do you know what e-waste is?
 - b. Do you have a program to address e-waste in the recipient countries?
 - i. Can you describe it?

A.2. Semi-structured interviews with recipient organizations

Research Questions:

1. Where do donated computers come from?
2. What happens to computers between arrival in country and disposal?

Goal: Learn how organizations receiving computers use, repair, and dispose of them.

Participants: Individuals at recipient organizations responsible for getting and/or maintaining donated computers.

Estimated length: 30 minutes

Questions:

1. Where do you get your computers?
2. How do you use them?
3. If you didn't have donated computers, would you have access to computing resources?
 - a. In what fashion?
 - b. How much would that cost you?
4. How long do you expect to use computers you receive?
 - i. What do you do when computers break or are retired?
 - a. *Probe: who do you sell them to?*
 - b. *Probe: how do you discard them?*
 - i. Who takes them away?
5. Do you know of any e-waste sites in Accra?

A.3. Semi-structured interviews with used computer dealers

Research Questions:

1. What happens to computers between arrival in country and disposal?
2. Where are they dumped?

Goal: Learn the economics of e-waste, and what happens to discarded computer parts.

Participants: Used Computer Dealers or Importers. Dealers will be located by storefronts and phone calls. Representatives of at least five companies will be interviewed.

Estimated length: 30 minutes

Questions:

1. Where do you get your computers/parts?
 - a. Do you buy from individuals?
 - b. Do you buy from other companies?
 - c. Do you buy in bulk?
 - d. Do the computers work when you buy them?
 - e. Do you have contact information for them?
2. How much do various parts cost you?
3. How much do you sell whole PCs/parts for?
4. Do you disassemble computers for parts?
 - a. Do you further disassemble the parts?
 - b. What parts do you try to take from them?
5. What do you do with parts you cannot use?
 - a. Do you sell them?
 - b. If so, how much do you get for them?
 - c. Do you throw them away?
 - d. If you throw it away, who takes it away?
6. Do you know of any e-waste sites in Accra?

A.4. Semi-structured interviews with informal waste recyclers

Research Questions:

1. Where is e-waste dumped?
2. What are the socio-political and economic dynamics that surround the dumpsites?
3. What are the human and environmental health effects?
4. Are any negative effects being meaningfully addressed?

Goal: Understanding the economic and social livelihoods of informal waste recyclers, and their role in e-waste dumping. Are there negative health effects? Do informal waste recyclers have a meaningful say in mitigating health and environmental effects?

Participants: Informal waste recyclers. At least five individuals will be interviewed. Individuals will be located either through personal observation or through contacts with used computer dealers.

Estimated length: 30 minutes

Questions:

1. How old are you?
2. Do you live near here or just work here?
 - a. If not here, where do you live?
3. Do you work for yourself, or someone else?
4. Do you need permission for this work?
 - a. From who? License? Other?
5. What do you take?
 - a. Who do you sell it to?
6. Do you collect things from other sites?
 - a. Do you know of other sites?
 - b. If so, where are they?
7. Who else takes these things from this site?
8. Who brings e-waste here?
 - a. What sorts do they bring?
9. How much do you earn at this/each site?
10. How much do you work at this/each site?
11. Why did you choose this location?
12. Has anyone tried to stop you from taking things?
 - a. Who?
 - b. How do they control the site?
13. Do you have a family?
 - a. Do they help collect?

A.5. Semi-structured interviews with officials at Ghana EPA

Research Questions:

1. What are the human and environmental health effects on the community?
2. Are any negative effects being meaningfully addressed?

Goal: Understand the awareness, responsibilities, and actions of the EPA

Participants: Officials at EPA Ghana

Estimated length: 30 minutes

Questions:

1. What are your environmental priorities?
 - a. Probe: what about waste?
2. Is dumping illegal?
 - a. Probe: How is it enforced in theory?
 - b. Probe: How is it enforced in practice?
3. Have you ever considered the question of electronic waste?
 - a. Probe: have you done anything specific about it?
4. Does the government attempt to clean up informal waste dumps?
5. Does the government monitor formal or informal waste sites?
 - a. Any data available?

A.6. Semi-structured interviews with city sanitation officials

Research Questions:

1. Where is e-waste dumped?
2. What are the human and environmental health effects of e-waste?
3. Are any negative effects being meaningfully addressed?

Goal: Understand the economics of e-waste disposal and the priorities of the city for managing waste, in particular e-waste.

Participants: Officials at Waste Management Department of the Accra Metropolitan Assembly

Estimated length: 30 minutes

Questions:

1. What are your priorities for dealing with waste?
2. How are you implementing those priorities?
 - a. Probe: what neighborhoods are the highest priority?
3. How does the city manage trash?
4. Does the government attempt to clean up informal waste dumps?
5. What is your budget?
 - a. *Is that adequate to accomplish your goals?*
6. What, if anything, does the city do with e-waste?
7. Are you aware of any e-waste dumps?
 - a. Who is responsible for handling these sites?
 - b. Are you doing anything about them?
8. Is potentially hazardous material treated differently?
9. Is e-waste treated specially?
 - a. How so?

A.7. Focus group discussion

Research Questions:

1. Are negative effects from e-waste being meaningfully addressed?

Goal: Gain understanding of political dynamics regarding e-waste. Work to find meaningful avenues of community participation in environmental decision making.

Participants: Approximately 10 individuals, drawn from residents from areas near dumpsites, and informal waste recyclers.

Estimated length: 120 minutes

Questions:

1. Who decides where waste is dumped?
2. Who make other environmental decisions?
3. Who do you take your general concerns to?
 - a. Who do they report to?
 - b. Who do you take health concerns to?
 - c. Who do they report to?
 - d. Do you feel your concerns are listened to?
 - e. Are they addressed?
 - f. Probe: How so?
 - g. Probe: How not?

A.8. Community mapping exercise

Research Questions:

1. What are the dynamics surrounding waste sites?
2. Are there any human or environmental effects?

Goal: Understand community perceptions of e-waste sites. Understand the social dynamics surrounding them. Learn about health effects.

Participants: 5-10 residents from the community near the e-waste sites. An approximately equal number of men and women should be chosen.

Estimated length: 120 minutes

Materials: Large sheet of paper, colored markers

Directions:

1. Draw your neighborhood. Include any important landmarks. Don't hesitate to talk amongst yourselves! If you want to work alone or with someone else, that's your choice.
2. As a group, draw your three favorite places.
3. Question: Why did you choose these places?
 - a. [each in turn] Why do you like this place?
4. Now draw places you don't like. (no limit)
 - a. [each in turn] Why do you don't like this place
5. Are any of them dangerous?
 - a. Why?

Questions:

Before exercise, in private:

1. How long have you lived here?
2. How many people in your family?
3. How old are you?
4. Is this a good place to live?
5. How long do you want to stay here
6. What do you do for a living?

If waste dumps are not noted:

7. Where do you throw things out, when you throw them out?
8. Where do other people throw things out?

If waste dumps are noted:

9. Who puts things in this dump?
 - a. Probe: what do you know about them?
10. What goes in those dumps?
 - a. Probe: is any of it dangerous?
11. Are those dumps burned?
 - a. Where does the smoke go?
 - b. How long does the fire last?
 - c. How long does the smoke stay?
12. How long has the dumpsite been there?
13. Have you seen any (new) health problems since it arrived?
 - a. Probe: what sort?
14. Who are the people at the dumpsites?
15. Does anyone decide who can put things in the dump?
 - a. Who are they?
16. Do people remove things from the dump?
17. Does anyone decide who can take things out of the dump?
18. Are the dumps safe to visit?
 - a. If not, why not?
 - b. Do children play there?
19. How long has the e-waste been here?
20. Do you know why the dump is at this location?

Appendix B: Import/Export Tables

Table 5: Aggregated sources of computer imports to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
Europe	1	1,276,632	3,203,093	4,124,034	4,170,972	1,963,973	14,738,704	57.4
North America	2	1,542,995	1,600,617	1,638,042	1,840,793	796,862	7,419,309	28.9
Asia	3	289,522	616,928	652,485	795,182	428,557	2,782,674	10.8
Oceania	4	14,792	113,951	139,451	109,664	42,664	420,522	1.64
Africa	5	64,477	56,862	80,876	45,079	61,200	308,494	1.20
South America	6	230	613	15,482	31	14	16,370	0.06
Total	NA	3,188,648	5,592,064	6,650,370	6,961,721	3,293,270	25,686,073	100

[†]Through June 28, 2007

Table 6: Sources of computer imports to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
United States	1	1,415,096	1,295,320	1,354,403	1,556,859	628,219	6,249,897	24.3
Great Britain	2	394,008	1,032,955	1,522,002	1,870,112	942,105	5,761,182	22.4
Netherlands	3	283,262	639,062	627,292	689,991	300,529	2,540,136	9.89
Belgium	4	107,557	321,614	767,402	600,670	251,187	2,048,430	7.98
Germany	5	162,231	334,510	517,316	381,352	179,956	1,575,365	6.13
Canada	6	125,911	298,334	283,198	280,941	167,540	1,155,924	4.50
China	7	11,458	99,351	255,361	380,839	256,700	1,003,709	3.91
Italy	8	58,653	170,471	136,063	163,846	89,398	618,431	2.41
Denmark	9	150,701	179,953	116,663	96,556	18,322	562,195	2.19
United Arab Emirates	10	51,303	145,415	150,171	107,360	58,290	512,539	2.00
France	11	28,004	73,004	104,676	116,281	53,974	375,939	1.46
Spain	12	29,740	39,968	124,134	96,972	41,411	332,225	1.29
Australia	13	5,622	63,765	111,783	97,294	42,215	320,679	1.25
Norway	14	6,078	65,532	113,589	72,464	23,870	281,533	1.10
South Korea	15	35,307	48,749	62,339	54,124	40,399	240,918	0.94
Japan	16	54,664	64,602	51,541	50,875	16,823	238,505	0.93
Ireland	17	3,793	144,087	21,370	34,823	17,794	221,867	0.86
Sweden	18	13,843	121,005	18,987	25,402	27,715	206,952	0.81
Taiwan	19	13,605	101,364	3,363	36,329	18,193	172,854	0.67
Switzerland	20	32,725	43,268	48,125	14,080	3,766	141,964	0.55
South Africa	21	28,790	27,209	41,208	20,280	18,185	135,672	0.53
Turkey	22	4,665	14,087	37,630	48,152	2,155	106,689	0.42
Israel	23	67,152	12,045	6,962	7,808	3,351	97,318	0.38
New Zealand	24	5,788	50,126	27,668	12,365	449	96,396	0.38
India	25	4,196	48,746	7,703	5,201	15,364	81,210	0.32
Lebanon	26	1,241	17,283	21,895	37,513	1,049	78,981	0.31
Ghana	27	28,786	21,688	8,117	7,691	8,230	74,512	0.29
Hong Kong	28	10,519	18,516	11,462	23,774	9,131	73,402	0.29
Finland	29	2,610	27,014	3,209	5,152	7,545	45,530	0.18
Saudi Arabia	30	6,774	6,853	15,806	7,401	250	37,084	0.14
Singapore	31	7,080	9,598	5,412	9,353	2,959	34,402	0.13
Thailand	32	5,286	8,198	4,038	5,717	3,638	26,877	0.10
Nigeria	33	929	580	10,789	6,812	2,506	21,616	0.08
Malaysia	34	318	12,178	325	7,090	0	19,911	0.08
Oman	35	0	93	17,502	64	187	17,846	0.07
Indonesia	36	6,055	4,434	657	4,696	0	15,842	0.06
Brazil	37	0	17	15,482	15	14	15,528	0.06

[†]Through June 28, 2007

Table 6: Sources of computer imports to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
Togo	38	0	254	10,424	4,157	253	15,088	0.06
Egypt	39	502	352	670	0	13,094	14,618	0.06
Botswana	40	292	1,257	1,988	2,974	5,763	12,274	0.05
Senegal	41	0	43	1,970	0	9,889	11,902	0.05
Austria	42	1,819	866	2,567	1,716	2,733	9,701	0.04
Portugal	43	718	8,378	12	326	204	9,638	0.04
North Korea	44	9,118	285	35	0	0	9,438	0.04
Netherlands Antilles	45	734	6,647	0	1,302	728	9,411	0.04
Cote D'Ivoire	46	2,176	1,277	1,654	1,020	2,492	8,619	0.03
Iran	47	0	29	0	7,571	0	7,600	0.03
Kuwait	48	183	3,646	109	999	0	4,937	0.02
Greece	49	15	845	289	185	2,843	4,177	0.02
American Samoa	50	2,883	0	0	5	0	2,888	0.01
Gambia	51	70	125	1,730	5	0	1,930	0.01
Kenya	52	466	391	782	35	240	1,914	0.01
Namibia	53	509	1,232	0	50	0	1,791	0.01
Niger	54	846	709	72	0	0	1,627	0.01
Pakistan	55	0	1,326	41	30	0	1,397	0.01
Zimbabwe	56	249	0	386	532	0	1,167	0.01
Guadeloupe (French)	57	0	30	0	1,014	0	1,044	0.00
Tanzania	58	70	70	6	713	58	917	0.00
Antigua and Barbuda	59	0	0	331	370	142	843	0.00
Russian Federation	60	20	139	44	350	274	827	0.00
Uruguay	61	230	536	0	0	0	766	0.00
Zambia	62	50	450	91	168	0	759	0.00
Virgin Islands (British)	63	300	58	71	307	0	736	0.00
Nicaragua	64	632	0	0	0	0	632	0.00
Cameroon	65	124	0	426	0	81	631	0.00
Luxembourg	66	550	20	57	0	0	627	0.00
Gabon	67	0	562	0	0	0	562	0.00
Morocco	68	253	39	69	43	0	404	0.00
Syria	69	206	0	0	190	0	396	0.00
Ukraine	70	0	0	0	390	6	396	0.00
Ethiopia	71	0	73	0	252	60	385	0.00

[†]Through June 28, 2007

Table 6: Sources of computer imports to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
Jamaica	72	322	24	39	0	0	385	0.00
Libya	73	68	230	36	51	0	385	0.00
Albania	74	0	0	0	53	326	379	0.00
Algeria	75	0	196	147	19	0	362	0.00
Sierra Leone	76	10	0	20	0	320	350	0.00
New Caledonia (French)	77	273	60	0	0	0	333	0.00
Hungary	78	0	57	0	240	0	297	0.00
Bangladesh	79	276	0	0	0	0	276	0.00
Czech Republic	80	95	149	0	0	0	244	0.00
Burkina Faso	81	200	0	0	0	0	200	0.00
Dominican Republic	82	0	46	0	0	147	193	0.00
Qatar	83	80	0	64	34	0	178	0.00
Rwanda	84	0	0	166	0	0	166	0.00
Bahamas	85	0	158	0	0	0	158	0.00
Iceland	86	0	0	142	0	0	142	0.00
Georgia	87	0	90	18	30	0	138	0.00
Malawi	88	0	0	0	132	0	132	0.00
Bulgaria	89	130	0	0	0	0	130	0.00
Mauritius	90	0	125	0	0	0	125	0.00
Latvia	91	0	95	19	4	0	118	0.00
Marshall Islands	92	100	0	0	0	0	100	0.00
Cayman Islands	93	0	0	0	0	86	86	0.00
Norfolk Island	94	86	0	0	0	0	86	0.00
Sudan	95	0	0	0	81	0	81	0.00
Slovenia	96	80	0	0	0	0	80	0.00
Somalia	97	0	0	80	0	0	80	0.00
Romania	98	0	20	50	0	0	70	0.00
Cyprus	99	0	0	0	0	68	68	0.00
Peru	100	0	60	0	0	0	60	0.00
Liberia	101	0	0	45	14	0	59	0.00
Jordan	102	0	0	25	32	0	57	0.00
Tunisia	103	0	0	0	50	0	50	0.00
Uganda	104	50	0	0	0	0	50	0.00
Slovak Republic	105	0	25	2	6	15	48	0.00

[†]Through June 28, 2007

Table 6: Sources of computer imports to Ghana (kg)

	Rank	2003	2004	2005	2006	2007[†]	Total	%
Papua New Guinea	106	40	0	0	0	0	40	0.00
Philippines	107	20	20	0	0	0	40	0.00
Congo	108	37	0	0	0	0	37	0.00
Bosnia-Herzegovina	109	0	29	0	0	0	29	0.00
Swaziland	110	0	0	0	0	29	29	0.00
Malta	111	0	27	0	0	0	27	0.00
Poland	112	0	0	24	1	0	25	0.00
Kazakhstan	113	0	0	20	0	0	20	0.00
Vietnam	114	0	20	0	0	0	20	0.00
Sri Lanka	115	16	0	0	0	0	16	0.00
Colombia	116	0	0	0	12	0	12	0.00
Bahrain	117	0	0	6	0	0	6	0.00
Argentina	118	0	0	0	4	0	4	0.00
Total	NA	3,188,648	5,592,064	6,650,370	6,961,721	3,293,270	25,686,073	100

[†]Through June 28, 2007

Table 7: Aggregated sources of used computer equipment to Ghana (kg)

	Rank	2003	2004	2005	2006	2007[†]	Total	%
Europe	1	989,100	2,652,453	3,549,083	3,605,342	1,696,263	12,492,241	63.0%
North America	2	1,291,956	1,312,159	1,397,779	1,558,138	658,465	6,218,497	31.4%
Asia	3	134,894	171,250	122,270	160,610	65,370	654,394	3.3%
Oceania	4	11,731	80,026	109,223	104,170	39,610	344,760	1.7%
Africa	5	12,123	21,298	43,220	11,010	25,951	113,602	0.6%
South America	6	0	0	0	16	2	18	0.0%
Total	NA	2,439,804	4,237,186	5,221,575	5,439,286	2,485,661	19,823,512	100

[†]Through June 28, 2007

Table 8: Sources of used computer equipment to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
United States	1	1,185,770	1,029,680	1,151,403	1,291,791	524,928	5,183,572	26.2
Great Britain	2	275,658	859,559	1,357,851	1,654,585	827,662	4,975,315	25.1
Netherlands	3	236,999	526,949	546,065	623,352	278,346	2,211,711	11.2
Belgium	4	87,263	305,098	705,702	566,015	228,600	1,892,678	9.55
Germany	5	127,219	274,234	408,507	313,878	144,084	1,267,922	6.40
Canada	6	105,152	280,771	245,974	264,368	132,434	1,028,699	5.19
Italy	7	47,424	138,634	119,849	146,230	77,762	529,899	2.67
Denmark	8	138,872	121,795	104,926	47,338	11,585	424,516	2.14
Spain	9	26,378	39,340	78,524	93,093	39,324	276,659	1.40
Australia	10	4,751	52,405	81,592	92,158	39,210	270,116	1.36
Norway	11	5,992	56,045	112,714	70,873	23,715	269,339	1.36
Japan	12	53,587	60,878	50,051	38,447	16,232	219,195	1.11
Sweden	13	10,265	120,402	18,486	25,202	16,944	191,299	0.97
Ireland	14	119	135,342	21,198	12,869	13,133	182,661	0.92
South Korea	15	22,687	31,895	24,698	30,498	12,698	122,476	0.62
Switzerland	16	15,947	33,221	43,349	12,956	3,579	109,052	0.55
China	17	3,034	22,594	17,868	45,647	12,411	101,554	0.51
France	18	12,630	4,565	26,159	32,370	23,058	98,782	0.50
New Zealand	19	5,733	27,561	27,631	12,012	400	73,337	0.37
Israel	20	34,303	7,984	2,975	833	1,006	47,101	0.24
South Africa	21	3,529	12,211	23,753	1,950	3,743	45,186	0.23
Finland	22	2,444	27,014	3,124	5,031	7,545	45,158	0.23
Hong Kong	23	4,069	7,457	8,169	14,869	7,425	41,989	0.21
United Arab Emirates	24	1,057	16,618	1,808	7,624	3,503	30,610	0.15
Saudi Arabia	25	5,227	2,664	6,932	7,082	83	21,988	0.11
India	26	2,944	0	2,507	1,915	11,340	18,706	0.09
Singapore	27	387	7,316	707	9,190	483	18,083	0.09
Ghana	28	5,398	5,121	2,103	1,420	437	14,479	0.07
Egypt	29	142	54	670	0	13,000	13,866	0.07
Nigeria	30	306	66	9,992	2,288	0	12,652	0.06
Botswana	31	45	1,167	1,796	1,544	5,763	10,315	0.05
Portugal	32	718	8,378	12	0	0	9,108	0.05
Malaysia	33	208	5,832	99	733	0	6,872	0.03
North Korea	34	6,313	247	0	0	0	6,560	0.03
Cote D'Ivoire	35	1,092	27	1,654	950	2,175	5,898	0.03
Austria	36	1,172	776	2,265	1,313	206	5,732	0.03

†Through June 28, 2007

Table 8: Sources of used computer equipment to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
Oman	37	0	93	4,242	64	0	4,399	0.02
Indonesia	38	0	4,184	160	0	0	4,344	0.02
Netherlands Antilles	39	734	1,550	0	1,302	728	4,314	0.02
Taiwan	40	714	663	0	1,435	189	3,001	0.02
Thailand	41	32	920	749	1,291	0	2,992	0.02
Togo	42	0	0	642	1,331	105	2,078	0.01
Namibia	43	509	1,232	0	50	0	1,791	0.01
Gambia	44	0	0	1,705	5	0	1,710	0.01
Greece	45	0	845	267	87	394	1,593	0.01
Niger	46	846	709	0	0	0	1,555	0.01
Kuwait	47	70	570	0	882	0	1,522	0.01
American Samoa	48	1,247	0	0	0	0	1,247	0.01
Pakistan	49	0	1,182	0	15	0	1,197	0.01
Lebanon	50	0	63	1,083	0	0	1,146	0.01
Antigua and Barbuda	51	0	0	331	370	142	843	0.00
Tanzania	52	70	70	0	618	58	816	0.00
Kenya	53	0	279	238	0	240	757	0.00
Virgin Islands (British)	54	300	58	71	307	0	736	0.00
Zimbabwe	55	49	0	0	532	0	581	0.00
Cameroon	56	0	0	426	0	81	507	0.00
Albania	57	0	0	0	53	326	379	0.00
Sierra Leone	58	0	0	20	0	320	340	0.00
Zambia	59	50	0	91	168	0	309	0.00
Libya	60	68	230	0	0	0	298	0.00
Russian Federation	61	0	80	44	97	0	221	0.00
Dominican Republic	62	0	46	0	0	147	193	0.00
Qatar	63	80	0	64	34	0	178	0.00
Syria	64	166	0	0	0	0	166	0.00
Czech Republic	65	0	149	0	0	0	149	0.00
Malawi	66	0	0	0	132	0	132	0.00
Turkey	67	0	0	113	19	0	132	0.00
Senegal	68	0	20	82	0	0	102	0.00
Georgia	69	0	90	0	0	0	90	0.00

†Through June 28, 2007

Table 8: Sources of used computer equipment to Ghana (kg)

	Rank	2003	2004	2005	2006	2007 [†]	Total	%
Cayman Islands	70	0	0	0	0	86	86	0.00
Ethiopia	71	0	73	0	0	0	73	0.00
Morocco	72	0	39	3	22	0	64	0.00
New Caledonia (French)	73	0	60	0	0	0	60	0.00
Jordan	74	0	0	25	32	0	57	0.00
Liberia	75	0	0	45	0	0	45	0.00
Luxembourg	76	0	0	41	0	0	41	0.00
Guadeloupe (French)	77	0	30	0	0	0	30	0.00
Swaziland	78	0	0	0	0	29	29	0.00
Malta	79	0	27	0	0	0	27	0.00
Jamaica	80	0	24	0	0	0	24	0.00
Kazakhstan	81	0	0	20	0	0	20	0.00
Congo	82	19	0	0	0	0	19	0.00
Sri Lanka	83	16	0	0	0	0	16	0.00
Colombia	84	0	0	0	12	0	12	0.00
Argentina	85	0	0	0	4	0	4	0.00
Brazil	86	0	0	0	0	2	2	0.00
Total	NA	2,439,804	4,237,186	5,221,575	5,439,286	2,485,661	19,823,512	100

[†]Through June 28, 2007

Table 9: Aggregated destinations of scrap metal exported from Ghana (kg)

	Rank	2004	2005	2006	2007 [†]	Total	%
Asia	1	3,229,904	8,047,195	12,838,135	5,785,497	29,900,731	62.5
Europe	2	4,105,621	5,285,031	3,499,216	1,391,356	14,281,224	29.9
Africa	3	1,844,182	914,920	501,867	214,493	3,475,462	7.27
South America	4	23,120	111,160	19,920	0	154,200	0.32
North America	5	25,000	0	0	0	25,000	0.05
Oceania	6	0	0	0	250	250	0.00
Total	NA	9,227,827	14,358,306	16,859,138	7,391,596	47,836,867	100

[†]Through June 28, 2007

Table 10: Destinations of scrap metal exported from Ghana (kg)

	Rank	2004	2005	2006	2007 [†]	Total	%
China	1	878,080	4,563,842	5,003,873	1,087,869	11,533,664	24.1
Germany	2	2,523,340	2,919,970	2,001,890	245,620	7,690,820	16.1
India	3	1,269,339	886,031	1,954,792	1,022,880	5,133,042	10.7
South Korea	4	878,635	1,638,102	643,060	564,070	3,723,867	7.79
United Arab Emirates	5	0	0	2,302,600	831,320	3,133,920	6.55
Great Britain	6	832,633	1,181,380	415,741	100,450	2,530,204	5.29
Netherlands	7	62,900	230,120	645,860	810,406	1,749,286	3.66
Hong Kong	8	115,360	190,960	1,059,260	186,388	1,551,968	3.24
Belgium	9	547,210	694,690	171,800	29,940	1,443,640	3.02
Kenya	10	429,200	480,400	185,560	207,493	1,302,653	2.72
Singapore	11	0	0	620,000	660,000	1,280,000	2.68
Malaysia	12	0	0	385,590	605,390	990,980	2.07
Ghana	13	307,422	366,100	305,307	0	978,829	2.05
Mali	14	974,400	0	0	0	974,400	2.04
Spain	15	91,240	230,291	168,045	204,940	694,516	1.45
Taiwan	16	59,710	239,660	167,120	113,200	579,690	1.21
Vietnam	17	0	148,930	0	400,000	548,930	1.15
Sri Lanka	18	0	88,650	227,800	43,880	360,330	0.75
Bangladesh	19	0	0	200,000	100,000	300,000	0.63
Japan	20	28,780	118,100	140,420	0	287,300	0.60
Thailand	21	0	153,600	0	35,860	189,460	0.40
Colombia	22	23,120	111,160	19,920	0	154,200	0.32
South Africa	23	133,160	17,000	0	0	150,160	0.31
Philippines	24	0	0	90,060	0	90,060	0.19
Italy	25	0	0	53,880	0	53,880	0.11
Turkey	26	0	0	11,500	40,600	52,100	0.11
Pakistan	27	0	0	0	50,000	50,000	0.10
Portugal	28	48,140	0	0	0	48,140	0.10
Jordan	29	0	0	0	44,040	44,040	0.09
Switzerland	30	0	0	42,000	0	42,000	0.09
Burkina Faso	31	0	36,020	4,000	0	40,020	0.08
Cyprus	32	0	0	32,060	0	32,060	0.07
Cote D'Ivoire	33	0	15,400	7,000	7,000	29,400	0.06
Lithuania	34	0	28,580	0	0	28,580	0.06
United States	35	25,000	0	0	0	25,000	0.05

[†]Through June 28, 2007

Table 10: Destinations of scrap metal exported from Ghana (kg)

	Rank	2004	2005	2006	2007 [†]	Total	%
Indonesia	36	0	19,320	0	0	19,320	0.04
Australia	37	0	0	0	250	250	0.00
France	38	158	0	0	0	158	0.00
Total	NA	9,227,827	14,358,306	16,859,138	7,391,596	47,836,867	100

[†]Through June 28, 2007

Table 11: Aggregated destinations of copper scrap exported from Ghana (kg)

	Rank	2004	2005	2006	2007[†]	Total	%
Asia	1	610,790	2,276,512	3,766,573	804,228	7,458,103	79.2
Europe	2	609,860	183,988	516,751	387,070	1,697,669	18.0
Africa	3	112,630	21,260	0	0	133,890	1.42
South America	4	0	111,160	19,920	0	131,080	1.39
Total	NA	1,333,280	2,592,920	4,303,244	1,191,298	9,420,742	100

[†]Through June 28, 2007

Table 12: Destinations of copper scrap exported from Ghana (kg)

	Rank	2004	2005	2006	2007 [†]	Total	%
China	1	465,580	2,118,494	3,242,654	465,308	6,292,036	66.8
Germany	2	477,480	158,568	136,480	64,740	837,268	8.89
Netherlands	3	0	0	138,500	300,370	438,870	4.66
India	4	0	0	191,284	143,760	335,044	3.56
Sri Lanka	5	0	88,650	185,980	20,880	295,510	3.14
South Korea	6	145,210	65,140	20,680	41,300	272,330	2.89
Great Britain	7	109,280	25,420	92,031	0	226,731	2.41
Ghana	8	112,630	21,260	0	0	133,890	1.42
Colombia	9	0	111,160	19,920	0	131,080	1.39
Belgium	10	0	0	107,740	21,960	129,700	1.38
Hong Kong	11	0	4,228	32,480	22,240	58,948	0.63
Pakistan	12	0	0	0	50,000	50,000	0.53
Jordan	13	0	0	0	44,040	44,040	0.47
Switzerland	14	0	0	42,000	0	42,000	0.45
Japan	15	0	0	40,000	0	40,000	0.42
Malaysia	16	0	0	23,360	0	23,360	0.25
Portugal	17	23,100	0	0	0	23,100	0.25
Taiwan	18	0	0	15,000	5,000	20,000	0.21
United Arab Emirates	19	0	0	15,135	0	15,135	0.16
Thailand	20	0	0	0	11,700	11,700	0.12
Total	NA	1,333,280	2,592,920	4,303,244	1,191,298	9,420,742	100

[†]Through June 28, 2007

Appendix C: Components of Desktop Computers

**Table 13: Composition of a typical desktop computer
(based on a computer weighing ~70lbs.)**

	Content as % of weight	Recycling Efficiency	Use/Location
Silica	24.8803%	0%	Glass, solid state devices/CRT, PWB
Plastics	22.9907%	20%	Includes organics, oxides other than silica
Iron	20.4712%	80%	Structural, magnetivity/(steel) housing, CRT, PWB
Aluminum	14.1723%	80%	Structural, conductivity/housing, CRT, PWB, connectors
Copper	6.9287%	90%	Conductivity/CRT, PWB, connectors
Lead	6.2988%	5%	Metal joining, radiation shield/CRT, PWB
Zinc	2.2046%	60%	Battery, phosphor emitter/PWB, CRT
Tin	1.0078%	70%	Metal joining/PWB, CRT
Nickel	0.8503%	80%	Structural, magnetivity/(steel) housing, CRT, PWB
Barium	0.0315%	0%	Getter in vacuum tube/CRT
Manganese	0.0315%	0%	Structural, magnetivity/(steel) housing, CRT, PWB
Silver	0.0189%	98%	Conductivity/PWB, connectors
Tantalum	0.0157%	0%	Capacitors/PWB, power supply
Beryllium	0.0157%	0%	Thermal conductivity/PWB, connectors
Titanium	0.0157%	0%	Pigment, alloying agent/(aluminum) housing
Cobalt	0.0157%	85%	Structural, magnetivity/(steel) housing, CRT, PWB
Antimony	0.0094%	0%	Diodes/housing, PWB, CRT
Cadmium	0.0094%	0%	Battery, blue/green phosphor emitter/housing, PWB, CRT
Bismuth	0.0063%	0%	Wetting agent in thick film/PWB
Chromium	0.0063%	0%	Decorative, hardener/(steel) housing
Mercury	0.0022%	0%	Batteries, switches/housing, PWB
Germanium	0.0016%	0%	Semiconductor/PWB
Indium	0.0016%	60%	Transistor, rectifiers/PWB
Gold	0.0016%	99%	Connectivity, conductivity/PWB, connectors
Ruthenium	0.0016%	80%	Resistive circuit/PWB
Selenium	0.0016%	70%	Rectifiers/PWB
Gallium	0.0013%	0%	Semiconductor/PWB
Arsenic	0.0013%	0%	Doping agents in transistors/PWB
Palladium	0.0003%	95%	Connectivity, conductivity/PWB, connectors
Vanadium	0.0002%	0%	Red phosphor emitter/CRT
Europium	0.0002%	0%	Phosphor activator/PWB
Niobium	0.0002%	0%	Welding allow/housing
Yttrium	0.0002%	0%	Red phosphor emitter/CRT
Terbium	0.0000%	0%	Green phosphor activator, dopant/CRT, PWB
Rhodium	0.0000%	50%	Thick film conductor/PWB
Platinum	0.0000%	95%	Thick film conductor/PWB

Source: Silicon Valley Toxics Coalition (1999)

Appendix D: Toxics Fact Sheet

Chemical Name	Where does it come from?	How am I at danger?	What does it do to me?
Lead	<p>Solder in circuit boards.</p> <p>Glass from TV and monitor tubes (bottles).</p> <p>Car batteries.</p> <p>Rain can carry lead into the water, where humans or other animals eat or drink it.</p>	<p>Breathing smoke from burning circuit boards, or eating food that has been in the smoke.</p> <p>Drinking water that has come into contact with lead.</p> <p>Children are especially at danger if they put their hands in their mouths after playing near items with lead in them or near places where lead has been burned.</p> <p>Eating food, such as fish, which were exposed to lead while alive.</p>	<p>Lead collects in your body, it never leaves. The more lead that collects in your body, the more dangerous it is.</p> <p>Lead causes damage to the blood and nervous systems, and can also damage the kidneys and reproductive system.</p> <p>In children, even small amounts of lead in the body can cause learning problems and even brain damage.</p>
Cadmium	<p>Older cables and wires.</p> <p>TV and monitor tubes (bottles).</p> <p>Rechargeable batteries.</p> <p>Rain can carry cadmium into the water, where humans or other animals eat or drink it.</p>	<p>Breathing smoke from burning electronics, or eating food that has been in the smoke.</p> <p>Drinking water that has come into contact with cadmium.</p> <p>Eating food, such as fish, which were exposed to cadmium while alive.</p>	<p>Cadmium collects in your body, it never leaves. The more cadmium that collects in your body the more dangerous it is.</p> <p>Cadmium causes problems with the kidneys, and in large amounts it also damages bones.</p> <p>Frequent breathing of smoke with cadmium in it can cause lung cancer.</p>
PBDEs	<p>Cables and wires.</p> <p>Circuit boards.</p> <p>The plastic cases around electronics.</p> <p>If these items are burned, it can create new, more dangerous chemicals.</p>	<p>Breathing smoke from burning electronics, or eating food that has been in the smoke.</p> <p>Eating food, such as fish, which were exposed to PBDEs while alive.</p>	<p>Some types of PBDEs collect in your body, they ever leave. The more PBDEs that collect in your body the more dangerous it is.</p> <p>Frequent contact with PBDEs can cause learning and memory problems. Children, especially unborn children, are especially in danger from PBDEs.</p>

Figure 13: Toxics fact sheet given to community members in Old Fadama