Water, Energy, Access

Materializing the Internet in Rural Zambia

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Infrastructure is both the thing and the story. It is the transparent and the spectacular. It is seamless in its operation and can be disastrous in its failure. It is something we do not know whether we should want and something we think we cannot live without. It is what tethers us together and what sets us apart. This chapter explores the material conditions of Internet infrastructure in the rural community of Macha, Zambia. Located in the country's southern province, Macha is home to 135,000 Tonga people, many of whom speak Chitonga and English, the country's national language since 1964. The community is the site of a Brethren Church of Christ mission, a regional hospital and malaria research institute, several mission-run and state-supported schools, a small, open-air market, and an information technology academy, all of which are connected to the nation's electrical grid. Most Machans, however, live off the grid in small, scattered homesteads in extended families (see figure 5.1). Many are subsistence farmers who live on an average income of less than one dollar per day.[1] The nearest grocery store is seventy kilometers away in a city called Choma, and it costs five dollars to ride there on a minibus. It costs thirty dollars per month for a voucher to access the Internet.

In 2012 and 2013, I conducted fieldwork in Macha as part of a collaborative research project that involved partnering with community members to design sustainable Internet and mobile phone systems scaled to rural socio-economic conditions and informed by local needs, interests, and desires. This aspiration

Figure 5.1. Most Machans live in homesteads scattered around the center of this rural Zambian community. Photo by author.

to work closely with community members as part of the process of integrating information and communication technologies (ICTs) in rural areas arises on the heels of other ICT for development (ICTD) projects that have failed because of limited engagement with people who would be using new technologies.[2] Much ICTD work is underpinned by development ideology—a blind faith in the capacities of ICTs to "modernize" and "enhance" the lives of anyone fortunate enough to come within their reach. This development ideology sets the tone for many ICTD projects seeking to address the needs of the so-called "O3B" or "other 3 billion"—the mass of people still without Internet access who are alternately imagined as a technologically disenfranchised class or a giant untapped market.[3] In the context of such logics, many Africans feel their communities have either become test sites for Westerners doing feel-good ICT research or a dumping ground for the West's digital hand-me-downs—old computers and printers shipped to Africa, many of which are obsolete, broken, or incompatible with local electrical systems, and thus useless.[4] In Macha an entire cargo container sent from Europe and filled with computer equipment sat unused for months. After the container became infested with termites,

Figure 5.2. Machans could access the Internet from 2011 to 2012 from several LinkNet VSAT terminals built out of repurposed cargo containers. Photo by author.

much of its contents were burned, causing exposure to toxic incineration of plastic and metal parts. Other donated computers have piled up in storage rooms awaiting software installations.

Internet access was first established in Macha in 2004 through a VSAT system at the community's Malaria Institute at Macha (MIAM), run by Johns Hopkins University. Shortly thereafter, a local organization called LinkNet formed, and, with the support of the Dutch government, developed rural Internet services by installing cargo containers equipped with solar panels, VSAT systems, and computers in village sites, charging access fees with a voucher system (see figure 5.2). Access charges ranged from three kwachas (sixty cents) for a few minutes access to 150 kwachas (thirty dollars) for a month. These voucher revenues barely made a dent in the high-cost satellite gateway to the Internet, which ran up to seven thousand dollars per month and was subsidized by Dutch organizations and the UK company AfriConnect.[5] To expand the user base and generate more cost-sharing revenue, in 2009 LinkNet began installing a Wi-Fi mesh network in Macha that would enable it to collect service fees from schools, churches, the hospital, the radio station, and private residences.

After this change to the infrastructure, which was designed to extend access and generate revenue, financial problems for LinkNet persisted.

By 2012 LinkNet and its umbrella Macha Works[6] went bankrupt, and a clear digital divide had formed in Macha related to several factors. First, the community's early adopters were situated within the village's center, which was not only connected to the electrical grid but also to historically colonial institutions such as the hospital, the mission, and the schools. There has been little sustained ICT education of or outreach to people in the thirty-five-kilometer radius beyond Macha's center. Those who had familiarity with computing had either taken an International Computer Driver's License (ICDL) course offered by LinkNet's IT academy (LITA) or received ICT training outside of Macha. Second, most Machans do not know about computing or the Internet. Since Tonga is an oral culture, many have not learned to read or write in English, much less how to type or use a mouse, and therefore they have little interest in or incentive to adopt computer technology. Compounding this issue is the fact that the local indigenous language—Chitonga—was not used in LinkNet's Internet access instructions or on the Macha Works website. Third, most Machans, even those who knew about computers and the Internet, could not afford Internet vouchers or computer equipment and did not have electricity in their homes. Machans who wanted to access the Internet tended to do so opportunistically, either through their workplace or by looking over someone's shoulder. Fourth, as LinkNet was trying to establish Internet service in Macha and attract users, two commercial mobile phone providers, Airtel and MNT, managed to do so with more affordable pricing options through mobile phones, a much more familiar and readily accessible technology among Machans. Finally, in 2012 serious conflicts surfaced among the leaders of Link Net and Macha Works and the community's traditional stakeholders, an amalgam of local chiefs, leaders of the Brethren Church in Christ mission, Tonga spiritualists, and community members. These conflicts resulted in allegations of embezzlement and corruption, leading to litigation, extradition, and ongoing strife in the community. In the fall of 2012 Tonga sorcerers reportedly cast spells on former LinkNet employees, causing some to flee Macha and seek refuge in neighboring Zimbabwe.

To be clear, I am not an anthropologist or an Africanist. I am a media and communication scholar interested in the arrangement and use of ICTs, and since our fieldwork began in 2012, navigating through and making sense of these conflicts and shifting conditions up close and from afar has been challenging. I was asked to join this project because I had conducted fieldwork and ethnographically inspired research on uses of media technologies in rural communities in other parts of the world—specifically on Aboriginal Australian

uses of satellites and Mongolian uses of mobile telephony.[7] In addition, I have tried to develop critical materialist approaches for studying media infrastructures—the biophysical resources, designs, hardware, and labor organized to support the circulation of signal traffic across different cultural and territorial contexts.[8] Our ICT research in Macha continues this work by investigating the players, resources, and power struggles involved in the installation and use of Internet infrastructure in this rural African community. The focus is on formulating relational and hybrid understandings of the arrangement and use of ICTs across cultural contexts, not on the mastery of Others' cultures. In this way, the project builds upon the work of Eric Michaels, Faye Ginsberg, Brian Larkin, Jenna Burrell, and others who have explored how people in developing and postcolonial contexts have adapted or "reinvented" imported technologies, localizing and using them to contest Western hegemony, create tactics of cultural survival, or respond to oppressive state policies or socioeconomic conditions.[9]

So what I propose to explore here is the materialization of Internet infrastructure in rural Zambia, the technical facilities that enable local links to the global Internet as well as the natural resources, sociotechnical relations, and institutions that are organized to sustain these facilities and links. Since many Machans use mobile phones to access the Internet, I consider mobile telephony as part of their Internet infrastructure. By "materialization" I am referring to how "matter becomes." Studying materialization involves recognizing the constitution of phenomena as part of a "multitude of interlocking systems and forces," grasping the complex dynamics of causation, and tracking the "changing location and nature of capacities for agency."[10] Such study reveals the micro- and macro-level forces, contingencies, and conflicts that can inform and result from Internet infrastructure's emergence in specific locations and their relation to everyday culture.

The chapter begins with a discussion of the resource requirements of ICTs in Macha, drawing out the contingent relations between information, water, and electrical systems. Then, to convey ICT imaginings and uses within these conditions, I present a sampling of Machan Internet-access stories, focusing on the relation between Internet infrastructure and local agriculture, transportation, and gender politics. My fieldwork in 2012 and 2013 included site visits in and around Macha, videotaped interviews with nearly two hundred community members, group meetings, informal conversations, photography, and the installation and testing of an experimental wireless network called VillageCell. This research revealed that Internet infrastructure is inseparable from the electricity and human biopower that energizes it, the layering of systems that precede it

(such as water, agriculture, transportation), and the multifarious ways people imagine, use, and respond to it. Understanding the materialization of Internet infrastructure in rural Zambia works to destabilize dominant discourses that posit ICT diffusion and adoption in rural Africa as a straightforward path to "modernization," "development," and "global integration," and instead points to local political, economic, and cultural challenges to the Internet's globalization.

Energizing ICTs in Rural Zambia

It is impossible to think about or use the Internet or mobile phones in Macha (or perhaps anywhere) without thinking about water. In Zambia, hydropower is the primary source of electricity. Hydropower plants were built during the period of British colonial rule in the early twentieth century, in what was then Rhodesia, to support the copper mining industry in the northern part of the country, now known as the Copper Belt.[11] Today, hydropower plants in Kafue Gorge, Kariba North Bank, and Victoria Falls generate most of the country's electricity, which is networked on a grid administered by ZESCO—the Zambian Electrical Supply Company—and is connected to South Africa, Democratic Republic of Congo, and Zimbabwe. The grid also interlinks major Zambian cities and a handful of rural villages (especially those with hospitals or important facilities) and is used to export electricity to Botswana, Tanzania, and Namibia. Even though Zambia has a surplus of electricity from its hydropower resources, power goes on and off unpredictably almost every day in big cities and small villages alike. There are fluctuations and inconsistencies in the voltage, which can cause damage to computers and other electronics—not to mention fires—and power outages regularly interrupt Internet and mobile phone services. Other common causes of Internet downtime in Zambia are adverse weather conditions, low or shared bandwidth, and poor quality of copper cables and telephone connections.[12]

Rural communities such as Macha are particularly vulnerable to load shedding, the centralized practice of shutting off services to one area to support demand in another, often to the advantage of urban areas or clients abroad. Almost every day the power goes out in the community at unpredictable times, sometimes for a few minutes but often for a few hours. The graph in figure 5.3 shows the irregularities and fluctuations in power use over two weeks in Macha.[13] Most Machan Internet users I interviewed expressed frustration with this situation and described their use as punctuated by frequent disruption. Such conditions foreground the uneven temporalities of networks and experiences of Internet connectivity. Far from being a universal clock, homogeneous in its durations, the Internet's dynamism is contingent on the harnessing of energy
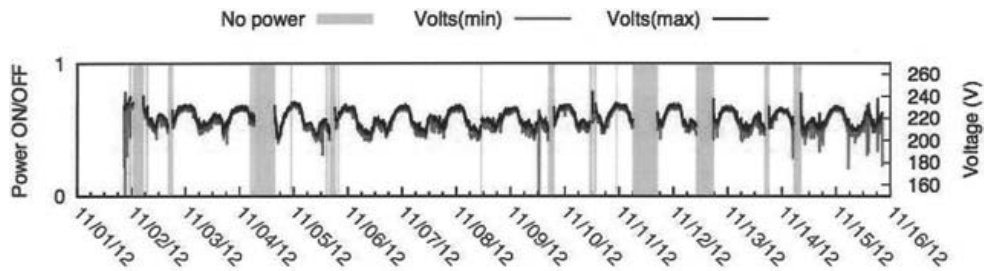
Figure 5.3. This graphic shows power voltage variations over a two-week period in Macha during 2012. The grey vertical bands represent power outages.

resources, the timed flow of electrical currents, and the regulation of voltage. While, as Tiziana Terranova reminds us, the Internet cannot be reduced to a grid or a database, its dynamism relies on steady access to electrical power.[14]

The integration of Internet and mobile-phone infrastructures within daily lives depends on the conversion of water, sun, fossil fuels, and other materials into electricity. In *Greening the Media*, Rick Maxwell and Toby Miller discuss the growing electrical demands of the global digital economy, noting, "By 2011, upwards of ten billion devices needed external power supplies, including two billion TV sets, a billion personal computers, and [six billion] cell phones."[15] Not only is the Internet powered by multiple energy sources, it is increasingly used in combination with sensors, cameras, and instruments to remotely monitor and manage the world's energy resources and extraction sites, whether oil pipelines, hydropower facilities, or nuclear power plants. Because of this, there is an urgent need to explore energy resource requirements as part of critical discussions of global signal traffic—that is, there is a need *to consider the external, material demands of information infrastructures in tandem with their internal dynamics, logics, forms, and cultures.*

In Zambia it is the movement of water through the country's sovereign territory, down rivers and into the mouths of hydropower plants that generates the capacity to access the Internet and use mobile phones. Having said this, it is important to point out that most Machans live "off the grid." It costs seventy-five thousand kwachas (fifteen thousand dollars) to electrify a home.[16] Given this high cost, most Machans power their devices in other ways. Some use power outlets at the outdoor market in the village center to charge their electronics and pay a fee to do so. Some use solar panels to power up radios, lights, and other small appliances. And some jerry-rig car batteries to energize TV sets and stereo systems. Consumer electronics are fueled not only by hydropower but also by the manual labor of people who take time and energy each day to devise

Figure 5.4. This sign appeared at Macha's open-air market, where people from the area come to charge mobile phones and other electronics. Photo by author.

ways of powering their devices and by local autodidacts who have figured out how to repair and maintain them.

Just off the dirt road leading to Macha's center, a local repairman works atop a small patch of cement outside an abandoned shop where people from the area drop off broken generators, radios, power converters, and other objects, hoping they can be repaired. The objects are arrayed around him as he kneels, crouches, or sits on the ground and works with a few coveted tools. The repairman cracks things open, pulls the pieces apart, lays them on pieces of cloth, tries to identify the problem, figures out a solution, finds or makes needed parts, and puts machines back together in an effort to extend their lives. Radios or mobile phones are fixed alongside and sometimes in relation to other objects such as small engines, bicycle wheels, or water pumps, which support daily life in this agricultural community. Skill and knowledge aggregate through regular and rigorous tactile engagements with different kinds of technical objects rather than via mastery over one thing. When there is a conundrum in repairing one object, another is tackled, and the solution for that repair may inform others.

As Steve Jackson suggests, such acts of repair are articulated with technological diversity, the circulation of knowledge/power, and the ethics of care.[17] Repair work also creates solutions for keeping machines and systems running in areas where energy, funding, and commodity flows are limited.

In addition to regular power failures in Macha, the community's water supply is limited and uneven. Though there is a central water tower in Macha (see figure 5.6), along with a few wells, most homes do not have modern plumbing or running water. Instead, there are spigots placed in sites throughout the community and, as in many other parts of the world, people (often women or children) convene around them and fill up large buckets or containers (when the water is flowing) and carry them home. Like electricity, sometimes water flows in Macha, and sometimes it ceases altogether, often at unpredictable times. As one informant explained, "My wife has to fetch water. You'll find that she'll go there for an hour or two, just to bring water. It's very often that maybe there'll be a queue, because of water delays, and that she could pump for eight minutes before water would come out. Or we will find that the whole day there won't be, there won't be water. So it's truly a challenge in Macha." While we were in Macha in 2012, our spigot was dry for three days. On such occasions, community volunteers fill large containers at the water tower's spillover basin or at a functioning spigot and haul them via tractor to people's scattered homes. Without water there could be no Internet or mobile phone users in this area. People need water to live; they need to be alive to use Internet and mobile phone infrastructure.

Put another way, *this* water infrastructure (see figure 5.5a)—the movement of water performed by Machan women—supports *this* Internet access (see figure 5.5b)—children in a local private school. Machan water carriers not only support and sustain their families but, in the logic of digital capitalism, their labor is implicitly commandeered to sustain populations on the cusp of becoming new markets for commercial Internet service providers and mobile telephone companies seeking to extend their enterprises into new regions as market saturation peaks in industrialized parts of the world. Reinforcing this point, an ad for Airtel, one of Zambia's most popular mobile phone networks, features an image of a prospective subscriber in a rural village setting and proclaims, "If you're out there, we will find you."

Relations between water and Internet infrastructure in Macha are materialized in another way as well. An array of transmitters has been mounted on the community's central water tower, which, at thirty meters, is one of the tallest points in the area (see figure 5.6). The water tower hosts Macha's community

Figure 5.5a. Women's bodies and labor are integral parts of water distribution infrastructure in Macha.

Figure 5.5b. School children use computers and access the Internet in a private Christian school in Macha. Photo by author.

radio transmitter as well as masts and antennas installed by LinkNet to extend the community's Internet infrastructure. Here water and signals transit through the same node. Internet infrastructure is quite literally supported by water infrastructure. The digital economy is layered upon the resource economy. Our research team contributed to this tower archaeology when we installed antennas and a base station to test an experimental mobile phone network called VillageCell, which uses the white space part of the electromagnetic spectrum to provide free local mobile-phone service in Macha.[18] The creation of telecommunication infrastructure, which is often done relatively invisibly by linemen and tower workers in urban and rural areas alike, is a biophysical process that involves assembling and hauling equipment, climbing up and down towers, measuring positions, making adjustments, and performing tests. After numerous challenges, our team finally managed to get VillageCell operating—only to have its base station struck by lightning and out of commission a few months later. Infrastructure development is a process that takes time and involves failure.

One motivating factor for our infrastructure research in Macha was the recognition that if an Internet user in the community wanted to send an email or share a photo with another person in Macha, the data would have to be routed

Figure 5.6. Macha's water tower hosts several antennas and was one of the sites of our team's VillageCell experiment. Photo by author.

up via satellite to servers thousands of miles away in Silicon Valley and then back down the satellite link through servers in Macha. As already mentioned, the community and its Dutch supporters were paying up to seven thousand dollars per month for the capacity to route data intended for local exchange through servers on other continents.[19] If this were not enough, the satellite Internet gateway experienced latency, slow speeds due to limited bandwidth, and frequent downtimes because of power outages. The technical portion of our research thus involved designing systems to support local control of data exchange and reduce cost, congestion, and Internet downtime.[20] Because of high gateway fees, it is five times more expensive for Zambians to access the Internet in rural areas than in urban areas.[21] In an effort to help alleviate high gateway costs, in 2011 AfriConnect provided a microwave Internet link in Macha, reducing LinkNet's monthly expense to four thousand dollars, which still proved too costly. The completion of a ten-thousand-kilometer transoceanic cable between Sudan and South Africa, called EASSy (which cost $263 million),

is expected to provide Zambia with a fiber-optic Internet link that will further reduce Internet access costs in the country's interior.[22]

Imagining and Accessing the Internet

In addition to considering the natural and human resources that support information infrastructure, our research in Macha explores how people imagine and use the Internet and mobile-phone technologies in the community. To develop this part of our work, we devised a collaborative ethnographic method that involved close partnership with twenty Machans.[23] First, we discussed a preliminary list of research topics and questions and then invited our partners to alter or add to it. Second, we trained our partners to use Flipcams and record interviews. Third, we asked them to conduct videotaped interviews of Machans in and beyond the community's center about their Internet and mobile phone use. Together our team conducted 178 videotaped interviews (some of which included multiple people) ranging from five to ninety minutes in length. A more extensive analysis of our ethnographic methodology and findings is developed in another publication.[24] For now, I want to provide a general overview of our findings and present some exemplary comments about ICT use in Macha.

Of the 135,000 people in Macha, approximately three hundred regularly used the Internet in 2012 via desktop or laptop computers. Those who access it do so through their work with the hospital or schools, and a select few have access at home. By 2013, after LinkNet had been shut down, a growing number of Machans were using their mobile phones to access the Internet. Most regular users reported familiarity with Google and Yahoo search engines and email services as well as Facebook and Skype, and indicated they use the Internet to seek information related to their work in fields of education, healthcare, and community development, and to read national and international news. Those who use Facebook do so primarily to connect with locals; some use it to stay in touch with family and friends who live in other parts of Zambia or abroad.[25] Most Machans we interviewed felt the Internet enhanced their lives by improving access to information and connecting their community to a broader sphere of activity. A select few indicated a concern with access to pornography and wasting time. They expressed favorable feelings about the technology's potential, often reiterating ICT development ideology, but complained about interrupted, slow, and costly access. When asked if the Internet should be free, most replied no, acknowledging that there are overhead costs associated with

Internet services that must be covered, yet some pointed out that the Internet in Macha has become primarily a technology for the rich.

Those Machans who use ICTs to access the Internet had a range of opinions and experiences to share. One Machan man conveyed the sense of intimidation he felt when first encountering a computer, indicating, "Yeah, when I was there learning, the fear came out, even to hold the computer, it wasn't an easy thing for me." A teacher who uses the Internet to prepare for his classes noted the frustration of being disconnected because of frequent power outages: "You find maybe for three days people given the mandate to run the Internet will just make an apology: Internet is down, we are doing everything possible. So the running down of the Internet. Also, the opening of the Internet. Those are the major challenges." Another Machan expressed the feeling of isolation that arose after being connected and disconnected: "You know, when you are not online, or when you are not connected to the Internet, it's more like you're outside the world. So, it's important that each and everyone looking at the civilized world we are in today—each one should be connected to the Internet. Each one should be updated with Internet, to know how things are around us." A hospital administrator emphasized how reliant he has become on his mobile phone: "I think the mobile phone is the center of information . . . without it, it's like life without blood. To a human being. Because I'll be paralyzed. I'll be completely paralyzed without this technology. And that's how I view it, because sometimes it creates information gap, when people don't reach you, when you don't reach them." Finally, Chief Macha emphasized the unpredictable potentials of new technologies: "Any technology can be very useful, but it can be misused. That's why one must be very careful. These phones that we use are very, very useful actually. Very, very useful. But they can be very destructive. I could misuse this for to kill you. I can misuse this for to do anything stupid. So it is a question of how you use the device."

Beyond conveying a sense of fear, utility, dependence, and the unpredictable outcomes of ICT use, Machans discussed a variety of other topics during our interviews, ranging from education to mobility, from time to technological breakdowns, from community development to resource access, from entertainment to employment. Our interviews revealed many issues of concern, but here I focus on three that recurred in our discussions: use of the Internet to support local farmers; use of the Internet to purchase used cars from Japan; and a lack of awareness of or an indifference to the Internet. Addressing these issues will foreground how the Internet has been imagined and used in relation to other existing infrastructures of agriculture, transportation, and communication,

Figure 5.7. Farmers around Macha have created ways of distributing important details about crop prices via Internet, radio, and mobile phone as they move around their farms. Photo by author.

and will highlight the reality that many Machans live without ever accessing the Internet and may not want it at all.

Daisy-chaining Crop Prices

Most Macha families are subsistence farmers, and some run larger farms that grow maiz, sunflowers, soy, ground nuts, and cotton. Farmers have found it increasingly important to know the crop prices set by the Zambian National Farmers Union before taking their crops to market so that they are not cheated by so-called "briefcase buyers" who buy crops at the lowest possible price. Since not all farmers in the community have Internet access, a practice has emerged whereby one farmer with Internet access finds crop prices or agricultural news online or listens to the radio and then broadcasts the information via text message to farmers with mobile phones. In this case, Internet and mobile-phone systems are productively interlinked or "daisy-chained" by information elites in the community. Mobile phone networks are used to extend the flow of information via personal networks into areas that either do not have Internet access

or do not have Internet users. The practice has also been performed by Macha's community radio station, which has operated since 2005 and reaches an area with a diameter of about 140 kilometers, covering at least four chiefdoms and potentially reaching 150,000 people.[26] Though the range of the radio station's coverage is expansive, crop prices are announced via radio only at fixed times during the day. Mobile phones allow the information to be circulated at the user's discretion. And farmers can receive information via text message as they move about their farms, whether they are outside or inside, or in transit to other areas (see figure 5.7). Similar cross-platform practices are beginning to occur in Macha with healthcare services as hospital workers are using mobile phones to push health alerts and immunization notices to people throughout the area.

Buying Used Cars from Japan

Several people we interviewed told stories about men in Macha using the Internet to buy used cars from Japan for two thousand to three thousand dollars via a website called Conjunction.com. The cars are shipped in cargo containers to Tanzania and then trucked overland across the border and driven across dirt roads into Macha. Interviewees expressed great pride and excitement about these major online purchases and self-satisfaction at being able to figure out how to buy some one else's used car sitting half a world away. They described the Internet as allowing them to participate within a global economy and to locate cars that would get good gas mileage and run forever. Imagining the Internet as a global marketplace has a different resonance in a rural community with limited access to commodity exchange, particularly to major appliances and automobiles. Machans shared excited accounts of the movement of this object that was manufactured in Japan and driven thousands of kilometers there, sold online, put in a cargo container, shipped across the seas, and delivered by truck to a person in Macha who could drive it for thousands of kilometers, evoking Arjun Appadurai's work on the social life of objects.[27] One car owner estimated that about seven thousand people in the area have bought used Japanese cars online.[28]

Within such conditions the resource economy of the Internet comes full circle. The movement of water generates electricity that energizes the movement of data, which catalyzes and completes an online transaction that results in the movement of a manufactured object from freeways in Japan, along shipping corridors on the high seas, through dirt roads in southern Zambia, and into the circuits of daily life in Macha. Internet access relies on hydropower at one end and intensifies local demand for gasoline on the other. Like electricity and water, gas supplies are limited in Macha. There is a makeshift gas station

Figure 5.8. This small gas station in Macha supports a growing number of used Japanese cars, which Machans have purchased online in recent years. Photo by author.

(see figure 5.8) in front of Macha's Blue Sky market that stays open until supplies run out, usually for a few hours. Gas is transported from Choma in large plastic tubs and sold on the side of the road in plastic bottles for 12.50 kwachas ($2.40) a liter. Thus as Internet access facilitates a sense of participation in the global economy, it alters local resource demands and modes of mobility such that humans, bicycles, oxen, dogs, and chickens now share the same dirt roads with Toyotas.

Never Heard of the Internet

While many of the women we spoke with carry water each day to sustain life, many had never heard of the Internet. Working with a translator, we talked to several groups of women at the fire camps outside the hospital where they prepare food and wait for family members receiving medical treatment. Most of these women, ages fifteen to seventy-five, live far beyond Macha's center, are part of extended families that live in traditional homesteads, and have had little, if any, formal education. When I asked if they had ever used or heard of the Internet, most simply shook their heads and seemed indifferent. And while

Figures 5.9a and 5.9b. Many women we interviewed at the fire camps near Macha's hospital indicated they have neither heard of nor used the Internet and expressed disinterest in it. Photos by author.

most had never heard of the Internet or used a computer, some had mobile phones. Several explained that they did not have enough money to buy talk time and used the mobile phone primarily to "ping" others and receive calls. They provide their numbers to family and friends so that they can receive incoming calls, but rarely can they afford to make outgoing calls. (Talk time can be purchased from local merchants as scratch cards in increments from .05 kwachas or thirty cents to fifty kwachas or ten dollars.) In addition to using the phone as a *receiver*, some prefer to use the mobile phone for group conversations rather than person-to-person phone calls. This way more people can participate in conversations without individually paying for talk time. On multiple occasions we witnessed people clustered around a single mobile phone with the speaker function activated, participating in a group conversation with a party on the other end, which suggests that Machans are using mobile telephony in ways that reconfigure and extend their oral cultures.

The discovery of how few Machan women knew about computers or the Internet generated discussion among members of our research team. On the one hand, the women's responses represented a gendering of the global digital divide, suggesting that rural Zambian women are geographically, socially, and economically positioned in ways that inhibit their capacity to learn computing and access the Internet, even though their labor and daily living routines (carrying water, farming, preparing food) may support others' Internet use. On the other hand, whether Machan women should or should not know about or use the Internet may ultimately be a question for them to broach on their own terms and decide. The women we spoke with seemed somewhat disinterested in the question and relatively content without the technology, foregrounding the reality that the digital divide may be as much an invention of Western humanitarianism and/or digital capitalism as it is a salient concern among Macha's rural residents. That so many women have never heard of the Internet caused me to reassess the very purpose of our project and to question whether or not we should be in Macha at all, particularly since the Dutch-supported ICT initiative had fallen apart and caused conflict in the community that led to a federal lawsuit in Zambia. Since there is no way for Westerners to engage in collaborative ICT work without the baggage of colonial pasts, development ideologies, and class and power hierarchies, and since we inherit and, in some cases, unwittingly evoke or reenact these conditions, how can international research collaboration be organized to craft imaginings and uses of ICTs that will expose, recalibrate, and reorder such relations? In the context of transnational feminist politics, is it vital for Machan women to know about and use the Internet? Certainly, there are many ways in which Internet access could support Machan women, but

under what conditions should the introduction of ICTs within their lives take place? How can ICTD research be used to stage interactions geared toward the introduction of technological potentials and possibilities as opposed to idly advancing deterministic agendas of technological integration, adoption, and revelry?

Though these questions persist, our Machan partners have told me that our work together has been useful because it provided an occasion to talk about and reflect upon the ways ICT use has been reconfiguring everyday life, movement, religion, education, commerce, and social relations in their community, something most of them had not discussed before. In the meantime, there has been much turmoil and uncertainty in relation to Internet service in the community. After LinkNet went bankrupt in 2012, its two leaders—one Dutch and one Machan—received death threats, and the Dutch leader left the community permanently. Remaining LinkNet staff worked for months without compensation to try and sustain the community's Internet access. Eventually they had to leave the area to look for work, and the mission seized all of LinkNet's equipment, much of which now sits dormant and is off limits to anyone in the community. The mission's leadership also cut electrical power to the water tower, which shut down the functionality of all antennas, including that belonging to the community radio station, for more than a month. Most Machans who used the Internet between 2012 and 2013 were doing so through their mobile-phone service provider. Figuring out how to proceed with our research in the midst of these conditions has been tricky, but our collaboration continues.

Conclusion

This fieldwork in Macha fundamentally altered the manner in which I imagine "Internet infrastructure" and its materiality. Site visits, interviews with Machans, technical installations and tests, and everyday experiences in the community brought forth the complexity of the Internet's operational dynamism—its contingency upon the coordinated appropriation of natural resources, electricity and batteries, and human biopower. In order for the Internet to become a widely accessible and useable "media infrastructure" in Macha, it will be necessary for Machans to collectively determine whether that is what *they* want. This will involve deciding whether to organize the community's limited resources to strengthen the local link to the national power grid or invest in reliable off-the-grid alternatives. It will involve acquiring computers, mobile devices, and software and creating educational programs to support digital literacy. And it will involve fostering local interest in Internet use beyond acts of downloading

information from elsewhere, and utilizing this infrastructure to support and reinvent Machan knowledge practices and ways of life.

Notes

1. For purposes of this chapter, "dollars" refer to U.S. currency.

2. For a discussion of these issues see Ineke Buskens, "Agency and Reflexivity in ICT4D Research: Questioning Women's Options, Poverty, and Human Development," *Information Technologies and International Development* 6, special edition (2010): 19–24; Alison Gillwald, "The Poverty of ICT Policy, Research, and Practice in Africa," *Information Technologies and International Development* 6, special edition (2010): 79–88; A. Glenn Maail, "User Participation and the Success of Development of ICT4D Project: A Critical Review," available at http://www.globdev.org/files/Shanghai%20Proceedings/5%20REVISED%20Maail_UserParticipationICT4DSuccess.pdf (accessed January 16, 2014); Andrew Skuse and Thomas Cousins, "Getting Connected: The Social Dynamics of Urban Telecommunications Access and Use in Khayelitsha, Cape Town," *New Media and Society* 10, no. 1 (2008): 9–26.

3. O3B has also become the brand name of a new satellite venture to deliver Internet services in emerging markets. See the company's website, http://www.o3bnetworks.com.

4. For a discussion of the second-hand computers in Ghana and Namibia, respectively, see Jenna Burrell *Invisible Users: Youth in the Internet Cafés of Urban Ghana* (Cambridge, Mass.: MIT Press, 2012); and Steven J. Jackson, Alex Pompe, Gabriel Krieshok, "Repair Worlds: Maintenance, Repair, and ICT for Development in Rural Namibia," *CSCW' 12*, February 11–15, 2012, Seattle, Washington.

5. Conference call with Gertjan van Stam, David Johnson, and Dick Uyttewaal, Macha, Zambia, July 5, 2012.

6. For more detail on the history of Macha Works see Gertjan van Stam, "Placemark: Macha" (2011); Gertjan van Stam and G. van Oortmerssen, G., "Macha Works!" *Frontiers of Society On-Line*, 2010; Raleigh J. Bets, G. van Stam, and A. Voorhoeve, "Modeling and Practise of Integral Development in Rural Zambia: Case Macha," in *Africomm 2012*; and Gertjan van Stam, "Information and Knowledge Transfer in the Rural Community of Macha, Zambia," *Journal of Community Informatics* 9, no. 1 (2013).

7. Lisa Parks, "Satellite Footprints: Imparja TV and Postcolonial Flows in Australia," in *Cultures in Orbit: Satellites and the Televisual* (Durham, N.C.: Duke University

Press, 2005), 47–76; Lisa Parks, "Walking Phone Workers," in *The Routledge Handbook of Mobilities*, ed. Peter Adey et al. (London: Routledge, 2013), 243–55.

8. Lisa Parks, "Earth Observation and Signal Territories: Studying U.S. Broadcast Infrastructure through Historical Network Maps, Google Earth, and Fieldwork," *Canadian Journal of Communication* 38 (2013): 1–24; "Postwar Footprints: Satellite and Wireless Stories in Slovenia and Croatia," in *B-Zone: Becoming Europe and Beyond*, ed. Anselm Franke (Barcelona: ACTAR, 2007), 306–47; "Where the Cable Ends: Television in Fringe Areas," in *Cable Visions: Television Beyond Broadcasting*, ed. Sarah Banet-Weiser, Cynthia Chris, and Anthony Freitas (New York: New York University Press, 2007), 103–26.

9. Eric Michaels, *Bad Aboriginal Art* (Minneapolis: University of Minnesota Press); Faye Ginsburg, "Embedded Aesthetics: Creating a Discursive Space for Indigenous Media," *Cultural Anthropology* 9, no. 2 (1993): 365–82; Heather Horst and Daniel Miller, *The Cell Phone: An Anthropology of Communication* (New York: Bloomsbury Academic, 2006); Brian Larkin, *Signal and Noise* (Durham, N.C.: Duke University Press, 2009); Jenna Burrell, *Invisible Users* (Cambridge, Mass: MIT Press, 2012).

10. Diana Coole and Samantha Frost, eds., *New Materialisms: Ontology, Agency, and Politics* (Durham, N.C.: Duke University Press, 2012), 9–10.

11. See James Ferguson, *Expectations of Modernity: Myths and Meanings of Urban Life on the Zambian Copperbelt* (Berkeley: University of California Press, 1999).

12. See Dean Mulozi, "Rural Access: Options and Challenges for Connectivity and Energy in Zambia," eBrain Forum of Zambia and IICD, January 2008, 24, available at http://www.iicd.org/articles/rural-access-to-the-internet-in-zambia-options-and -challenges#sthash.7B1vth5g.dpuf (accessed January 16, 2014).

13. Also see, Consider Mudenda, David Johnson, Lisa Parks, and Gertjan van Stam, AFRICOMM 2013: Fifth Annual IEEE EAI Conference on e-Infrastructure and e-Services for Developing Countries, Blantyre, Malawi, November 25–28, 2013.

14. Tiziana Terranova, *Network Culture: Politics for the Information Age* (London: Pluto, 2004), 47.

15. Rick Maxwell and Toby Miller, *Greening the Media* (Oxford: Oxford University Press, 2012), 29–30.

16. Mr. Mugonke, interview with research partners Peter Miyanda and Trywell Maliko, July 3, 2012.

17. Steven J. Jackson, "Rethinking Repair," in *Media Technologies: Essays on Communication, Materiality and Society*, ed. Tarleton Gillespie et al. (Cambridge, Mass.: MIT Press, 2013), 222.

18. See A. Anand, V. Pejovic, E. Belding, and D. L. Johnson. "VillageCell: Cost-Effective Cellular Connectivity in Rural Areas," ICTD '12, Atlanta, Georgia, March 2012; and M. Zheleva, A. Paul, D. L. Johnson, and E. Belding, "Kwiizya: Local Cellular Network Services in Remote Areas," ACM MobiSys, Taipei, Taiwan, July 2013.

19. David L. Johnson, Veljko Pejovic, Elizabeth M. Belding, and Gertjan van Stam, *ACM DEV Conference, ACM, 2012, 7*.

20. Ibid.

21. Dean Mulozi, "Rural Access: Options and Challenges for Connectivity and Energy in Zambia," eBrain Forum of Zambia and IICD, January 2008, 24, available at http://www.iicd.org/articles/rural-access-to-the-internet-in-zambia-options-and -challenges#sthash.7B1vth5g.dpuf (accessed January 16, 2014).

22. "Landlocked Countries Pin Their Hopes on EASSy Cable," *The East African*, undated, available at http://www.theeastafrican.co.ke/business/-/2560/679872/-/view/ printVersion/-/sc69iq/-/index.html (accessed January 16, 2014).

23. We worked with the following partners in 2012: Consider Mudenda, Trywell Maliko, Cashmore Sikabanze, Peter Miyanda, Ruth Chilweza, Nina Kyalifungwa, Angela Kafute, Sibalwa Ntabeni, Consider's wife, Shadrek Llumuno, Ascent Milimo, Austin Sinzala; and the following partners in 2013: Consider Mudenda, Gracious Chizanda, Mutinta Maambo, Evis Muunga, Peter Miyanda, Bernard Sishumba, Calvin Muunta, Shadrek Llumuno.

24. Lisa Parks and Lindsay Palmer, "Critical Reflections on Rural ICTD Research: Collaborative Ethnography in Rural Zambia," work in progress.

25. Johnson, *ACM DEV*.

26. Gertjan van Stam and Fred Mweetwa, "Community Radio Provides Elderly a Platform to Have Their Voices Heard in Rural Macha, Zambia," *Journal of Community Informatics* 8, no. 1 (2012), available at http://ci-journal.net/index.php/ciej/article/ view/870/832 (accessed January 16, 2014).

27. Arjun Appadurai, *The Social Life of Things: Commodities in Cultural Perspective* (Cambridge: Cambridge University Press, 1988).

28. Email from Consider Mudenda to Lisa Parks, March 18, 2013.