“Your Cloud Dries My River”

The Hidden Cost of Digital Preservation: The Environmental Impact

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Introduction

In this digital epoch, born-digital records are now the norm, requiring an assortment of technologies including semiconductors, computer chips, computers, wi-fi, and servers housed in data centers throughout the world to store the information that is being created. Numerous institutions have been digitizing their collections for years, and many, like the National Archives, have initiatives to ramp up the process in the name of access. But there's a cost to be paid for that document to be saved and it's more than just dollars. When we peek behind the curtain, the technology required to create, store and retrieve that information has a major environmental impact that can't be ignored, especially as we continue to create more digital content at a dizzying pace. While a lot has been written around archival theory and new practices as it pertains to digital preservation and born-digital records, not much has been written focusing on the environmental impacts of those practices. In this paper, I will look at the supply chain of what makes digital preservation possible and its ramifications on the environment and the people whose lives are affected by the exploitation of resources.

The Commodification of Nature

In her article *The Supply Chain of AI,* Ana Valdivia brings to light what she calls the "commodification of nature" and the ever-hungry, ever-growing industry of Artificial Intelligence (AI). The hardware required to power such technology necessitates a great deal of natural resources and as the demand grows, so does the consumption of raw materials. When looking at what goes into the manufacturing of semiconductors and other equipment necessary for

processing power, heavy metals and minerals are essential - not something one typically thinks of when scanning documents for preservation. Silicon, copper, tungsten, quartz, gallium and tin are but a few of the elemental ingredients that go into their creation thus opening global markets - and the door for environmental and labor abuses.

Because we've created a dependency on these minerals, any disruption to the supply chain can put a strain on the industry. In 2024 Hurricane Helene devastated the small town of Spruce Pine, North Carolina and while the town may be home to merely 2,000, its mines, however, supply between 80 and 90 percent of the world's quartz which is essential in semiconductor production (Osho-Williams, 20224). Taiwan is a world leader in the production of semiconductors and computer chips, an industry that requires staggering amounts of water to cool the equipment and clean silicon wafers (which are part of a semiconductor). Starting in 2021, the country faced an unprecedented drought that lasted three years and exposed its unsustainable water practices. During this time the government paid farmers to not plant rice and forced the chip companies to reduce their water consumption by only 15 percent. As the reservoirs dropped to below 20 percent capacity, the world's largest chip manufacturer, the Taiwan Semiconductor Manufacturing Company, began to bring in water trucks to maintain production. As a result of this drought chip companies have begun to build water recycling plants and the government has supported efforts to upgrade the country’s water infrastructure and build desalinization plants. (Feng, 2023) But is this enough? I think Taiwan and all countries for that matter need to reassess their water strategy, lax restrictions, cheap prices and shift towards

a more sustainable future. As climate change begins to take hold, these situations are only going to get worse.

Data Centers

Data centers are the nucleus of digital activity - the AI industry, digital preservation, your recent Facebook post, your favorite YouTube channel, your photos from your recent trip all end up there, not in the sky, as your cloud storage implies. These data centers are a massive drain on resources, particularly water and electricity. Electricity, of course, powers the enterprise while water is used to keep the servers cool. In their 2023 Annual Environmental Report, Google consumed 4.5 billion gallons of water globally in 2021 and in 2022 the number went up to 5.5 billion gallons. And that's just Google. There exists Amazon Web Services, Meta Platforms, Microsoft Azure, NTT Global Data Centres, Oracle, Equinix and CloudHQ to name a few.

Valdivia speaks specifically of the state of Queretaro, Mexico "becoming the location of the largest data center hub in Latin America" with 10 operational centers and another 18 planned. In an area that is already suffering from severe droughts, these centers only exacerbate the problem. The community of Maconi was approached in 2006 by the local government with a deal to extract water in exchange for improving infrastructure and providing access to drinking water. One of the largest water projects in Mexico, the Acueducto II fulfilled its promise to the citizens of Queretaro and its industrial parks but has failed the community of Maconi. Suffering from water scarcity, the community must now travel hours to get water. Born from this apathy

towards the environment and lower-income communities, local grassroots organizations have taken to protesting the construction of data centers like the group *Tu Nube Seca Mi Rio* (Your Cloud Dries My River) in Spain where a center is to be built in a rural area near the Tajo River. (Valdivia, 2023)

WATER[167]	Unit	2018	2019	2020	2021	2022
Global operational water[168]						
Water consumption	Million gallons	-	3,412.4	3,748.9	4,561.8	5,564.7
Water discharge	Million gallons	-	1,748.3	1,939.8	1,734.8	2,034.9
Water withdrawal	**Million gallons**	**4,169.8**	**5,160.7**	**5,688.7**	**6,296.6**	**7,599.6**

Figure 1. Google's data centers water use. Source: Google 2023 Annual Environmental Report.

Urban Minning in the Mountains of E-Waste

Each year upwards of 50 million tons of electronic waste, or e-waste, is generated globally. The average person updates their phone every two and a half years, servers last five to seven years and GPUs last between three to five years. Wealthier countries who benefit from the advances of technology tend to have more stringent environmental standards, so e-waste disposal comes with a higher price tag. To get around these requirements, it's shipped out of these countries with forged or falsified documents, license misuse, and corruption. (Favarin et al., 2023) With roughly only 20 percent of e-waste being recycled or legally disposed, where

does the rest of it go? (Pendergrass et al., 2019) In the article *Transnational trafficking networks of end-of-life vehicles and e-waste* Serena Favarin et al. explain that what doesn't end up in a landfill (4 percent) is shipped illegally to low-income countries (a shocking 76 percent). These countries "make profits from collecting, recycling, reusing, or disposing waste from richer countries" (Favarin et al., 2023), and with the costs associated with the disposing of more harmful waste, the profit margins are higher for illegal disposal.

E-waste contains many valuable metals which makes recycling profitable for these low-income countries. For instance, a ton of mobile phones supplies about 282 pounds of copper, 8 pounds of silver. 0.77 pounds of gold, 0.33 pounds of palladium as well as other valuable metals. (Favarin et al., 2023) E-waste typically moves to Sout-East Asia and Africa with Nigeria, Ghana, and China being some main importers and where thousands of low-income workers, including children, "urban mine" for those precious of materials to support themselves and families. Many methods are used to liberate the materials and to free copper wire from its plastic casing, open burns pits are employed, creating a cocktail of toxic smoke from other plastics that are also being burned. While economically beneficial, these countries lack the environmental and safety standards of wealthier countries, consequently people are exposed to arsenic, CFCs and other toxic materials. (Favarin et al., 2023) By illegally exporting our used phones, computers, laptops, monitors, servers, processors and other electronics, we're contributing to the creation of toxic waste lands and are complicit in the harm of others.

The supply chain has many facets, and one doesn't think about who or what builds the semiconductor, the processor, or the computer chip – in the 1950's my grandmother was part of a group of women who worked for AT&T building microchips but now the process is no longer done by hand but with sophisticated machines. Some companies, like Intel, have initiated internal recycling programs. A source from within the company told me that since the machinery is proprietary, once it's decommissioned, it must be destroyed, however the parts are then separated for recycling, scrapping, and waste.

Agbogbloshie Scrapyard, an informal recycling center. Ghana Photo by Muntaka Chasant 2020

Initiatives like that of Intel are the direction we need to be going. Smasung has started a recycling program at their retail locations where you can bring your old cell phone, regardless of

manufacturer for recycling. (Doane, 2023) Both Google and Microsoft have pledged to be carbon negative, zero waste and water positive by 2030 and while the creators of our technology have taken on this challenge, it's not a mess they should clean on their own. It's time for local governments to take responsibility for their own actions (or lack thereof) and take ownership of their resources - laws need to be written and e*nforced* and a shift in practices is essential. Unfortunately, there is still a way to go in changing the mindset of those in power. In July 2021, just eight days after the Basel Convention on e-waste management focused on the Agbogbloshie Scrapyard in Accra, Ghana, "the government showed up with bulldozers and armed military...and violently demolished the...Scrapyard." (Chasant, 2024) Ordered by the Accra Regional Minister, Henry Quartey, this response was purely impulsive with no regard to the consequences. By bulldozing the livelihoods of thousands of people, Mr. Quartey solved no problems but only made them worse as there are now smaller scrapyards throughout the area as well as in the homes of the workers. It's the poor who will suffer from a country's shame. These types of hasty responses are not in anyone's best interest; planning and strategizing are crucial for success.

Responses and Thoughts

For whom are we preserving the records if our actions are aiding in the exploitation of Earth's resources and contributing to climate change? Isn't it a core mission to bring to light and preserve the stories of those who have been marginalized by colonialization? Yet our waste makes its way to those same countries that have been through colonial terror only to experience another. I understand the causes are as complex as the solutions and overwhelming to think

about where to begin. Though the focus of this paper has been about the supply line of digital preservation, I feel I would be remiss if I didn't mention a least a few steps towards sustainability and the first is simply being aware; knowing how the technology you're using was created. While archives and other cultural heritage organizations account for a small portion of global technology use, what is preserved is significant and quickly growing, so it's imperative that cultural institutions evaluate their digital preservation practices. (Pendergrass et al.) Carli V. Lowe wrote an insightful piece called *Partnering Preservation with Sustainability* where she discusses how traditional methods of preservation should be reconsidered in the pursuit of sustainability. She argues, quite successfully in my opinion, that our ancestors devised these techniques based on centuries of experience versus our one century of technological advancement. From geographically specific architecture, passive air-conditioning systems to traditional practices, these applications are all steps to being environmentally conscious. (Lowe, 2020)

The article *Toward Environmentally Sustainable Digital Preservation* by Pendergrass et al. offers insight into other ways archivists and institutions can take steps to becoming better stewards of the environment. One consideration starts with appraisal and that environmental costs should be included in the criteria. Another important consideration is the level of preservation that should be applied – resource-intensive, minimal preservation or low resource preservation to determine acceptable loss. (Pendergrass et al.) Not all collections are the same, therefore resource-intensive standards shouldn't be applied across the board, especially if it's a digitized version of an existing analog record. And probably the most basic and fundamental

practice is that not everything should be saved, why waste time and resources on content that is truly ephemeral or duplicative. (Pendergrass et al.)

When we finally peel back the technological curtain, the magic of the “cloud” disappears and the dirty mechanics of it all comes to light. Sustainability is more than just labor or fiscal accountability; it’s being aware of the supply chain that fuels your preservation initiatives, the exploitation of resources both earthly and human, and our overdependence on them. Review your institution's policies and create ones that reflect environmentally responsible stewardship. Before you hit ctrl +s, take a moment and think about the resources used that are allowing you to preserve the document that you just scanned.

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