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# **Sustainable Songs: Sound Archives in Ecologically Sustainable Musical Culture**

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## **Abstract**

The sound archiving practice has been historically ecologically unsustainable of natural environments, both by way of recording production practice and the amount of fossil fuels required to maintain collections. While digitization may seem to be a method for lowering emissions as well as preservation, this practice has ecological issues as well, such as non-renewable resource use and electronic waste. There are possible strategies to mitigate resource use as well as the carbon footprints of archives while we search for better ways to preserve intangible cultural heritage and the environment.

## **Introduction**

The Anthropocene—a term coined by scientist Paul Crutzen to describe the current geomorphological period in which humans have made large impacts on the natural environment<sup>1</sup>—has implications that are not easily seen or comprehended. Humanity’s survival on Earth is dependent on permanent changes in how we perceive the metaphorical worlds we inhabit as well as the physical world. We also must consider what our values are regarding these worlds, and how we live within them. This includes adjusting unsustainable practices in musical and sonic culture, which requires thought about what music and sound in a sustainable world is.

In the case of archiving sound, the practice is inextricably linked with recording technology, because there is no sound archive without it. The recording industry has involved the use of natural resources (including fossil fuels) throughout its changes, including the most recent developments in technology and digitization. This critical application of cultural principles and

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<sup>1</sup> John Urry, *Climate Change and Society* (Cambridge: Polity Press, 2011), 39.

practices aligned with solving environmental and anthropogenic issues is referred to by musicologist Kyle Devine as “political ecology.” This is defined as “critical attention to the principles of action and the forms of social order that link material environments and human cultures.”<sup>2</sup>

Although art, heritage, and memory are intangible concepts existing outside a thought binary, rethinking sound archives in an uncertain future is necessary to determining what we want culture and heritage in sustainable life to look like. While they seem to take a backseat to discourse about urban planning and climate science in the American consciousness on sustainable life, if there is no thought given to the environmental impact of practices in memory, the risk of framing it as a non-essential practice is elevated. This is not without consequence.

In discussing memory, there are three terms used in archival science that can be used interchangeably, but for the purposes of this paper I separate their definitive use by using the J. Marquez Voutsas model cited in an article by Perla Olivia Rodriguez-Resendiz.<sup>3</sup>

<b>Term</b>	<b>Archival Definition</b>	<b>Sustainable Practice Context</b>
Conservation	“Use [of] foresight to adequately and permanently protect and safeguard the document”	Finding solutions such as naturally dry climates to solve environmental threats to sound documents
Preservation	“Safeguard[ing] the long-term permanence of the document”	Practicing solutions to environmental threats to sound documents
Restoration	Process enacted “when such documents are damaged”	The environment could damage documents via flood, hot temperatures, etc.

My analysis on sustainability in sound archives explores the dematerialization of sound recordings, assesses the impact of resources used in sound archiving practices, (particularly digitization) and analyzes the general “carbon footprint” of sound archives and recording

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<sup>2</sup> Kyle Devine, “Decomposed: A Political Ecology of Music,” *Popular Music* 34, no. 3 (2015): 368.

<sup>3</sup> Perla Olivia Rodríguez Reséndiz, “Digital Preservation of Sound Recordings,” *Investigación Bibliotecológica: Archivonomía, Bibliotecología e Información* vol. 30, no. 68 (2016): 178. The original version is in Spanish, which I am unable to read.

materials. I also address possible solutions specifically for energy use in both analog and digital storage. Lastly, I am also exploring and questioning the anthropological value of sound archives in Western culture in an effort to support the relevance of sonic heritage during a time of critical thought and debate on resource allocation, as well as highlighting issues within the practice regarding sustainability.

### **Ecopolitical Archives**

Archival practice is an institution that (by way of materials used for recording as well as storing) has a historically unsustainable method of resource collection, which has also been exploitative of both humans and the environment. My research collects suggestions on what more sustainable practices could look like, as well as limitations in archival technology and philosophy, with the purpose of representing the cultural significance of sound archives. It is not simply to advocate for them, but to advocate for the practice in conjunction with ethical and sustainable ecopolitics. I demonstrate here that these issues surrounding resource allocation and use in the sound archiving practice are scientific in nature as much as they are anthropological. These qualities are not in opposition with one another, in fact, my approach is that archival practices are in direct alignment with the goals of environmentalism and sustainability: conservation and preservation, knowledge of heritage, foresight, and future use.<sup>4</sup>

### **Digitization and Development-Resource Use and Waste**

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<sup>4</sup> Heidi N. Abbey, "The Green Archivist: A Primer for Adopting Affordable, Environmentally Sustainable, And Socially Responsible Archival Management Practices," *Archival Issues* 34, no. 2 (2012): 92.

The intangible nature of sound easily lends it to digitization as a form of preservation, as sound is already easily disembodied from material culture in the human psyche (Lopez 2014). In the case of digital sound artifacts, the materials involved in its production are much further from the mind.<sup>5</sup> In a scenario where this is apparent, it still is difficult to visually imagine the physical space digital data sits in. It exists, then it does not.<sup>6</sup>

This dematerialization has led to a relative lack of concern regarding what resources are used in the streaming industry, as though “the cloud” is not truly supported by vast networks of cables under the ground and beneath the oceans. While the streaming industries do not function in the same way archives do, they are a measure of the capital and environmental costs of digitally storing music. In his book *Decomposed*, Devine investigated energy use at Tidal, a streaming company; he found that the administration was mostly unaware of how much energy their business operations cost, much less specific electricity costs for their servers.<sup>7</sup>

There are no real estimates on the energy use of server rooms,<sup>8</sup> but servers burn uranium and gas, and also require a roughly guessed estimate of “4000V DC submarine cables, 96 tons of batteries, thousands of liters of diesel fuel, millions of last-mile cabling and an electricity bill that comfortably reaches five figures every month.”<sup>9</sup> As of now, estimating the environmental impact of a few daily streams and document downloads is extremely difficult, but according to information systems researchers Van-Bussel et al., in 2008, storage networks were responsible for 15% of total information and communication technology (ICT) energy costs.<sup>10</sup> I have no

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<sup>5</sup> Devine, “Decomposed: A Political Ecology of Music,” 383.

<sup>6</sup> Francisco López, “Music Dematerialized?” in *Cochlear Poetics: Writings on Music and Sound Arts*, edited by Miguel Carvalhais & Pedro Tudela (Porto, Portugal; Research Group in Art and Intermedia, 2014).

<sup>7</sup> Devine, “Decomposed: A Political Ecology of Music,” 153.

<sup>8</sup> Devine, “Decomposed,” 135.

<sup>9</sup> Devine, “Decomposed,” 147.

<sup>10</sup> Geert-Jan Van Bussel, Nikki Smit, and John Van de Pas, “Digital Archiving, Green IT and Environment Deleting Data to Manage Critical Effects of the Data Deluge,” *Electronic Journal of Information Systems Evaluation* 18, no. 2 (2015): 189.

reason to suspect this has been reduced, as there are also more popular electronics, streaming services, and mobile applications than there were in 2008. ICT energy costs are more than likely continuing to rise.

Pioneering studies from the energy industry showed that servers “consume 1.5% of total US electricity, [and] their carbon-dioxide emissions are projected to surpass those of the airline industry by the year 2020.”<sup>11</sup> A small archive providing access to even a mere 5,000 recordings, while not a serious offender, (my aim is not to locate a culprit or argue against digitization) still contributes to this exorbitant energy and resource use.

The nature of digitization also lends it to a reputation of being a fail-safe, permanent method of maintaining an archive. It holds neither of those qualities—in fact, in her article “Digital Preservation: A Time Bomb for Digital Libraries,” archivist Margaret Hedstrom wrote that she “prefers the term ‘continuing’ rather than ‘permanent’ value to avoid both the absolutism and the idealism that the term ‘permanent’ implies.”<sup>12</sup> There are facets of fragility in digital storage,<sup>13</sup> stemming from human error, technological development, and to a lesser effect, natural disasters.<sup>14</sup> It does not hold up to a reputation of permanence, no more than any other archival or recording method, and may very well not be the ultimate solution to sustainable practice in sound archiving.

Accurate metadata is imperative to a digital sound archive because unlike a wax cylinder, a file in a large digital storage space would be virtually impossible to locate by sight, and the

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<sup>11</sup> Vytautas Valancius, Nikolaos Laoutaris, Laurent Massoulié, Christophe Diot, and Pablo Rodriguez, “Greening the Internet with Nano Data Centers,” in *Proceedings of the 5th International Conference on Emerging Networking Experiments and Technologies* (New York: ACM, 2009), 37.

<sup>12</sup> Margaret Hedstrom, “Digital Preservation: A Time Bomb for Digital Libraries,” *Computers and the Humanities* 31, no. 3 (1997): 190.

<sup>13</sup> Perla Olivia Rodríguez Reséndiz, “Digital Preservation of Sound Recordings,” 182.

<sup>14</sup> Reséndiz, “Digital Preservation of Sound Recordings,” 188.

possibility that it was somehow deleted would also hinder the search.<sup>15</sup> Physical objects can't simply disappear in such a manner. In the case of a human error in inventory, even with backup methods built into the archival protocol, a lost digital-born file without correct metadata must be reacquired. Sound documents re-recorded from analog can be regained dependent on the condition of the media. In any case, digital storage can easily be compromised. The case of social networking website Myspace's server migration resulted in the loss of an informal archive of early internet culture, much of which was not stored anywhere else. 50 million songs were permanently erased from existence, save for the ones that were backed up elsewhere or survived through some method of cultural memory.<sup>16</sup>

Natural disasters are threatening in a similar way as the mass deletion scenario. While the original files can be replaced, a flood or fire in a server room would make the archive unusable until the restoration work is completed.<sup>17</sup> In this way, digital files are humbled to the same mortality as analog documents, unable to escape the elements.

Playback and recording devices have developed since the advent of audio technology, mostly for practicality and convenience's sake. Archival function is not a consideration, much less sustainability, and this is especially true in the case of digital-born recordings. Hardware can become obsolete relatively quickly, as does software, resulting in archivists and researchers being unable to "access many files that depend on these components."<sup>18</sup> As an archive that is difficult to access, or impossible, cannot fulfill its duty and is useless, resources must be

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<sup>15</sup> Reséndiz, "Digital Preservation of Sound Recordings," 189.

<sup>16</sup> Will Cox, "Myspace's Music Purge is the Latest Careless Cultural Loss We'll Regret," *The Guardian*, April 9, 2019; <https://www.theguardian.com/technology/2019/apr/10/myspaces-music-purge-is-the-latest-careless-cultural-loss-well-regret>.

<sup>17</sup> Reséndiz, "Digital Preservation of Sound Recordings," 189.

<sup>18</sup> Reséndiz, "Digital Preservation of Sound Recordings," 187.

allocated to ensuring digitized copies are in the most up-to-date formats and that the archive has current equipment.

The preferred file type of the International Association of Sound Archives (IASA) is the European Broadcast Union's Broadcast Wave Format due to its metadata capabilities, simplicity, and losslessness.<sup>19</sup> However, the IASA does not own or have any input toward the development of devices that support or even convert .wav files. MP4 is generally not the best storage option due to its lossy nature and inability to copy with sound integrity. Should the time come when .wav supporting software becomes inaccessible, or unusable for some reason, sound archivists will find themselves either losing collections or making yet another adjustment to the preservation system. The fault would directly fall on the lack of planned digital sustainability in the practice.

Even the most environmentally conscious archive has the potential to produce devastating amounts of electronic waste while maintaining digital storage and accessibility simultaneously. In the above scenario where hardware and software become obsolete, accessibility is dependent on technological material. A computer, for example, contains only 2% of the materials required for assembly. The remaining 98% becomes e-waste.<sup>20</sup> Disposal of ICTs generate millions of tons of waste each year,<sup>21</sup> 80% of which is exported to unregulated landfills in developing countries, left to poison the land and groundwater.<sup>22</sup>

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<sup>19</sup> Kevin Bradley, "Critical Choices, Critical Decisions: Sound Archiving and Changing Technology," in *Researchers, Communities, Institutions, Sound Recordings*, edited by Linda Barwick, Allan Marett, Jane Simpson and Amanda Harris, (Sydney: University of Sydney, 2004), 8; <https://ses.library.usyd.edu.au/handle/2123/1431>. When an audio file is described as "lossless" this means it has near all of the quality of the original recording.

<sup>20</sup> Frans Berkhout and Julia Hertin, "De-materialising and Re-materialising: Digital Technologies and the Environment," *Futures* 36, no 8 (2004): 907.

<sup>21</sup> Berkhout and Hertin, "De-materialising and Re-materialising," 908.

<sup>22</sup> Geert-Jan Van Bussel, Nikki Smit, and John Van de Pas, "Digital Archiving, Green IT and Environment. Deleting Data to Manage Critical Effects of the Data Deluge," 188.



There is also the Jevons effect. While working with natural, tangible materials, the notion that production had efficiency limits worked within the production. You simply cannot take what is no longer there, and you wouldn't take what no longer serves its purpose. However, with digital storage, the Jevons effect is applied when "greater efficiency in resource usage is actually followed by greater consumption of that resource. Greater consumption then leads to a need for increased efficiency, which in turn leads to more consumption, which subsequently requires greater efficiency."<sup>23</sup> The dematerialized idea forms a loop, leading to institutions archiving more and more recordings because the space is now "unlimited." And yet, the digital format is heralded in many industries as "green" because the idea that we could create and keep infinitely more media while simultaneously using less resources never seemed too good to be true.

## **Materials**

Some archives do maintain analog collections, and many operate under the principle that analog versions will not be disposed of until they reach the end of life, when they can no longer be conserved or preserved. Conserving analog material requires specific climates that must be maintained by fossil fuels. This theoretically raises the carbon footprint of archives, given that a study by the U. S. Energy Information Administration revealed "buildings and their operations required the use of fossil fuels that consumed as much energy as the industry and transportation sectors combined and contributed almost half of the carbon emissions and greenhouse gases that are linked to global climate."<sup>24</sup>

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<sup>23</sup> Devine, "Decomposed: A Political Ecology of Music," 33.

<sup>24</sup> Heidi N. Abbey, "The Green Archivist: A Primer for Adopting Affordable, Environmentally Sustainable, And Socially Responsible Archival Management Practices." *Archival Issues* 34, no. 2 (2012): 92.

Machines such as humidifiers and air conditioners are employed to maintain temperatures and relative humidity where lacquer disks and magnetic tape media are stored because the most important part of slowing degradation is stability.<sup>25</sup> This would likely result in energy-sucking cooling measures and dust filtration for archives in warm climates, such as Tucson, Arizona, and incredibly difficult for the United States' Southwestern region in general.

Given the likely inflated emission rates of analog storage, it could be easier to make the case for all-digital archives despite the issues with the practice I described. Even in a scenario where issues with conservation with digital preservation do not exist, the intersection of society, ecopolitics, and archival philosophy do not allow for such a simple conclusion. Many metrics will have to be examined before we can truly know whether digital archives produce less waste and use less resources than analog or physical archives. There also remains the possibility of mixed methods remaining the most sustainable practice.

### **Archival Value & Environmental Policy**

For all the definitions for “policy” the concept ultimately is expected to support the well-being of the policy maker’s constituents.<sup>26</sup> By this interpretation, energy policy is responsible for sustaining human life on Earth as well as addressing needs central to human comfort and the good of the species. Therefore, environmental ethics and energy policy intertwine with sound archiving when two questions are asked: Do memory and artifacts fit in an environmentally sustainable world? What happens if we forget?

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<sup>25</sup> IASA Technical Committee, *Guidelines on the Production and Preservation of Digital Audio Objects*, edited by Kevin Bradley *Standards, Recommended Practices and Strategies*, second edition, 2009, [www.iasa-web.org/tc04/audio-preservation](http://www.iasa-web.org/tc04/audio-preservation). The goal of artifact preservation is to prolong its life as much as possible because degradation can’t necessarily be prevented.

<sup>26</sup> Jacob Bethem, “Life Within Energy Policy,” *Relations: Beyond Anthropocentrism* 6 no. 1(2018): 73.

Thomas Sterner et. al described seven guiding principles for modern environmental policy:

1. Inherent complexities necessitate interdisciplinary collaboration in the design of appropriate policies and governance systems.
2. In order to identify the appropriate strength and type of policy it is important to ascertain how serious the environmental problems are. If possible to measure, this could be given by the distance to the various boundaries.
3. Links across planetary boundaries often necessitate considering two or more of them together—both because policy approaches tackling one boundary may lead to “ancillary” benefits elsewhere, and because of potential conflicts, where a policy that mitigates human impacts on one dimension exacerbates threats to another.
4. Despite the novelty and complexity of the task, a number of well-known policy instruments exist. The challenge, thus, is not to invent entirely new approaches, but to select and design appropriate policies given specific scientific, societal, and political contexts.
5. Instrument selection depends on a proper diagnosis of the socioeconomic cause(s) underlying the problem, focused on the most significant points of leverage.
6. Effective policy choice and design needs to be based on efficiency, achieving desired outcome at lowest costs, but must also consider “political” criteria such as the distribution of costs and resistance by powerful vested interests.
7. Finally, global problems need policy instruments and agreements that are operational at both international and local levels, to ensure not only efficient outcomes but also effective jurisdiction and governance. (2–3)

While policy makers may or may not be aware of (or believe) the seriousness of continued carbon dioxide pollution, sound archives are still a part of the interdisciplinary approach described as central to designing effective policy. It is possible that at some point, in consideration of principles 2-4 and 6, resource allocation for heritage organizations is significantly reduced under the rationale that there simply is no real objective for memory if we are having major sociological issues due to shrinking amounts of comfortable, habitable

environments on Earth. Can archivists be prepared to defend the practice, and insist that heritage be considered in holistic policy?

In consideration of developing ecopolitical strategies, Frank Biermann et al. replaced the idea of “environmental policy” with the concept of “earth system governance.”<sup>27</sup> As I’ve demonstrated the connection of sonic heritage to the earth system, it is important that “governance” of the environment be considered alongside methods, opportunities, and objectives for archiving sound. This can only be effective with full analysis of the fifth principle, which essentially encourages critical analysis of socioeconomic conditions creating environmental issues as well as how they might affect policy and governance.

It is my hope and belief that heritage, specifically sonic heritage, will be a serious consideration in earth system governance. The ability to reflect “the history of artistic, cultural, scientific and political heritage of humanity”<sup>28</sup> is instrumental in developing culture as well as affecting the ways it influences society.

Viewing archives and cultural heritage from an ethnographic standpoint, such as UNESCO does,<sup>29</sup> creates the best case for their support. As Anthony Seeger noted in his 1986 article calling for reform in sound archiving, the study of music in cultures can be impeded by archival practice when collection is prioritized above the reasons for collecting, and what has been collected. This demonstrates why it is necessary to bring sustainability and resilience into archival practice. It is not simply keeping things for the sake of having them. If such was the case, sound archives would be the first to pull the plug in efforts to mitigate carbon emissions.

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<sup>27</sup> Frank Biermann, “Navigating the Anthropocene: Improving Earth System Governance,” *Science* 335, no. 6074 (2012): 1306.

<sup>28</sup> Reséndiz, “Digital Preservation of Sound Recordings,” 190.

<sup>29</sup> Ray Edmondson, *Audiovisual Archiving: Philosophy and Principles*, 3<sup>rd</sup> edition (Paris: UNESCO, 2015).

I'm arguing in favor of their relevance because they are about the sounds those who came before us heard, what they meant, and what sounds we might make in the future. In fact, ethnomusicological principles of sound archiving represent the most crucial differences between earth system governance and environmental policy: by acknowledging how the natural environment's wide-ranging effects can affect us not only physically, but perhaps culturally. Reforming common thought around the reasons the environment has been disturbed so rapidly must include culture, and in turn, archives.

### **What Can We Do?**

If humanity's sonic heritage looks bleak at this point, there are methods to address some of the aforementioned issues that plague preservation practice during these unstable times. This is the basis of the concept of *conservation* in sustainability, which addresses not only emissions mitigation, but also stresses foresight for the purpose of adaptation and resilience.<sup>30</sup>

In the case for analog preservation, building infrastructure can be adjusted to help reach the specified temperature range for analog preservation. Poul Klenz Larsen et al. summarize their article on energy efficient climate control in archives stating:

Ten years experience of low energy museum storage in Denmark confirms the practicality of building lightweight stores on uninsulated floors, in contact with the ground which acts as a thermal buffer. The high summer RH [relative humidity] is best reduced by dehumidification, which can be intermittent and therefore solar powered (1).

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<sup>30</sup> Eira Tansey, "Archival Adaptation to Climate Change." *Sustainability: Science, Practice, and Policy* 11, no. 2 (2015): 7.

While Denmark's climate is not uniform to all archives, physics can be used to determine what kind of infrastructure best regulates humidity and temperature in varying locations, and what kind of changes are most likely to be made as climates grow more unstable.

It is also possible that in the future, archivists decide that analog conservation can be sustainably practiced by hosting only a few archives in regional areas where either humidity or temperature can be naturally controlled. For example, St. Catherine's Monastery in Sinai, Egypt, has held a zero-emission library for 1500 years. Inside, "the annual temperature variation...is 20 – 30 °C <sup>31</sup> and the RH is 15 –30%. The low RH is characteristic of this high desert environment" (Larsen et al. 2). While this has worked for the books stored there, the temperature is far outside the recommended range for sound documents. Air conditioning could help, while the tolerable RH would offset the costs and emissions. It is difficult to imagine such a scenario in varying climates, especially with regard to accessibility, because of the different challenges they pose. However, it is important to note that efforts to adapt to sustainable practices and culture do require flexibility and ingenuity, as a "'one size fits all' approach is idealistic and impractical... [and] achieving sustainability requires responsiveness and adaptability to identify and overcome challenges as they present."<sup>32</sup>

While I have mainly focused on larger, structural adaptations, Abbey notes a number of changes that can be implemented into everyday practice (2012). Building maintenance, for example, can improve the resource use levels of archives. Regularly checking for leaks, broken temperature and humidity controls, and using efficient lights such as LEDs can lower energy use of any building, including a sound archive. Using recycled products for promotional material and

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<sup>31</sup> This is 68–86 degrees Fahrenheit.

<sup>32</sup> Abbey, "The Green Archivist: A Primer for Adopting Affordable, Environmentally Sustainable, And Socially Responsible Archival Management Practices," 109.

other purposes, as well as reducing material use helps also (106). For new archives, or those that have the ability to make landscape decisions, trees help mitigate dust entering through the air conditioner, as well regular upkeep of filters. While indoor plants may not be good for the vault areas, they do filter the air outside of the vault and can result in less work for the machines clearing the air in those areas.<sup>33</sup> And of course, archives should be willing to adopt all possible renewable energy systems, such as solar or wind power, whenever possible, as well as being responsible with the energy sources that are available. Of course, these are not simple suggestions, as they do have implications that must be considered in their implementation, but they start somewhere.

## **Conclusion**

Given the rapid changes in technological and social responses to climate change, this research does not come to a definitive conclusion or answer to the problem at hand. Creating new norms for sustainable life is a daunting task for every industry, and heritage has a particularly unique stake in molding those systems. For this, archivists' hands are not completely tied. They have the ability and perspective to do more than simply comply with regulations and react to circumstances, as well as the responsibility to use diversity of thought to decide what is best for individual collections, cultures, and people.

Some of the aforementioned strategies have the potential to bring significant changes to the ecological burden of sound archives, however, it is difficult to predict what the needs of the practice might be in such an uncertain future. There will be technological developments and

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<sup>33</sup> Shubha Chaudhuri, "How Do You Turn a House into an Archives? Air Conditioning and Tape Storage in a Hot and Humid Environment," in *Archives for the Future: Global Perspectives on Audiovisual Archives in the 21st Century*, edited by Anthony Seeger and Shubha Chaudhuri (Calcutta: Seagull Books, 2004), 145.

practices that will affect archival science, similar to the steps taken with digitization and digital access as well. Regardless, the environmental policy and cultural adaptation needed from this point to sustain a habitable planet are unprecedented, but heritage has always sustained in some form. I hope and believe it will continue to do so.



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