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Distributed Records in the Rohingya Refugee Diaspora: Arweave and the R-Archive

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**Distributed Records in the Rohingya Refugee Diaspora:  
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## Introduction

This article discusses the motivation for, and development of the pilot phase of the blockweave-based Rohingya Archive (hereafter the R-Archive). The R-Archive is a post-custodial digital archive, which means that it does not have a physical counterpart and only digital copies of physical records are maintained within it (Caswell, 2020, p.26; Shein and Lapworth, 2016). The article first provides some background regarding the Rohingya people and the historical and current abuses and bureaucratic violence that they have experienced in Arakan (now called Rakhine State) in Burma (called Myanmar by its current government), in southeast Asia. Detailing the impetus behind the R-Archive's creation, the article then outlines the blockweave technologies on which it is built, and how they work to reduce the environmental impact of intensive computation that is characteristic of blockchain applications. It also discusses the design and implementation of the R-Archive pilot and the archival and trust challenges that surfaced in the process. It considers the socio-technical and juridical issues that arise at this archival intervention at the intersection of rights, records, technologies, jurisdictions, economics and politics, and concludes with a reflection on the entire endeavour, its next steps, and its potential to serve as a model for similar grassroots archival activism by oppressed, marginalized and diasporic communities.

## The Systematic Oppression of the Rohingya People in Burma Through Bureaucratic Violence and Cultural Destruction

The Rohingya people are an Indo-Aryan ethnic group who have historically resided in Rakhine, or Arakan as it is locally known. A predominantly Muslim population with a largely clan-based social structure, the Rohingya have faced a long history of state persecution that, it has been argued in recent years, meets the criteria for genocide (UN, 2018). Although the early leaders of independent Burma frequently used the term “Rohingya” in official records and procedures to signal the inclusion of the Rohingya in the Burmese nation, the current government refuses this categorization and instead classifies the Rohingya people as “Bengalis” and has forced them to be recorded as such, for example, in the 2014 national census. Such “weaponization” (Carbone, Gilliland and Montenegro, 2020) by the state of the census and other forms of official records against the Rohingya people is part of a longer history of using what anthropologists term “bureaucratic violence” (Eldridge and Reinke, 2018; Graeber, 2015; Gupta, 2012) as a key mechanism for denying the historical citizenship of Rohingya people in Burma and suppressing their identity as a community.

Rakhine existed as an independent kingdom for centuries until 1784 when it was conquered by the Burmese Konbaung Dynasty. In 1823 it came under British colonial occupation. Following the independence of Burma in 1948, tensions between nationalistic elements within the Burmese government and society and the

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4 Rohingya people became evident, although the Rohingya still enjoyed full citizenship  
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6 status and a level of civic participation. Beginning in the 1970s, a series of military  
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8 operations by the Tatmadaw regime in Rakhine State resulted in the first exodus of  
9  
10 Rohingya refugees from their homeland, and the Rohingya were no longer issued  
11  
12 National Registration Certificates as citizens. With the passage of the 1982  
13  
14 Citizenship Law in Burma, the Rohingya people were excluded from the 135 state-  
15  
16 recognized “indigenous races”, and were effectively stripped of citizenship, along  
17  
18 with concomitant political and civil rights (Human Rights Watch, 2000). The  
19  
20 determination of whether or not ethnic groups were considered to be full citizens was  
21  
22 determined on a discretionary basis by the Council of State, a quasi-legislative  
23  
24 constitutional authority of Burma. The absence of the Rohingya in this listing  
25  
26 effectively conceded the narrative that they are the descendants of foreign Bengalis  
27  
28 labourers who were brought to the state of Rakhine during British colonial rule. This  
29  
30 legislative measure accelerated the exclusionary process leading to the current  
31  
32 stateless limbo in which the Rohingya exist today (Garcia, 2019). A “stateless  
33  
34 person” is someone who is not classified as a national by any state under its law.  
35  
36 While many stateless individuals are considered refugees, one does not have to be a  
37  
38 migrant or to have crossed international borders to be considered stateless  
39  
40 (UNHCR, 1954). The juridical status of citizenship allows for access to state-issued  
41  
42 identification records such as identity cards and passports, which can subsequently  
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44 facilitate access to a range of educational, financial and healthcare services in one’s  
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46 own or other states. Furthermore, institutional protections and the ability to exercise  
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4 certain basic rights are dependent upon active membership within a nation, or  
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6 recognition by a wider political community of one's citizenship, but such membership  
7  
8 or recognition is only available to those who have these kinds of records (O'Carroll,  
9  
10  
11 2022; Gilliland and Carbone, 2020; Arendt, 1951). In recent decades and culminating  
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13  
14 with a particularly large-scale military campaign in 2017, successive waves of  
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17 Rohingya people left their homeland due to fear of persecution by the Burmese  
18  
19 forces. They now reside as a stateless diaspora of approximately 3.5 million people,  
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22 many of whom are living in refugee camps, often under dire conditions, in multiple  
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25 countries including India, Pakistan, Bangladesh, Malaysia, Thailand, Indonesia and  
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28 Saudi Arabia and often have limited or no access to services in their host countries  
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30 primarily due to documentation issues (Natalie, 2019).

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33 The Rohingya have also suffered extensive cultural destruction and lost heritage.  
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36 They face a significant threat of cultural erosion both inside and outside Burma. As  
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39 legal and genocide scholar Melanie O'Brien notes, "In Myanmar, the Rohingya are  
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42 denied the ability to preserve their culture, notably through prohibitions on education,  
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45 religious practice, and the commonplace social and communal traditions of their  
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48 society" (2020, p.51). In diaspora, the Rohingya must adopt the linguistic and other  
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51 practices of their host societies in order to assimilate and survive. Cultural  
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54 preservation, then, can also be a form of resistance to ongoing pressures and  
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56  
57 repression that threaten to erase Rohingya culture at home and abroad. The  
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60 targeting and destruction of cultural practices and traditions associated with a group  
have also been recognized as a form of genocidal activity (Bilsky and Klagsbrun,

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4 2018; Novic, 2016). Philosopher Claudia Card has argued that “Genocide not only  
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6 intentionally strips individuals of the ability to participate in social relationships,  
7  
8 activities, and traditions, it aims to destroy the possibility of those particular kinds of  
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10 relationships, activities, and traditions for others in the future” (2010, p. 265).  
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13  
14 While the genocidal campaign against the Rohingya by the military junta in Burma  
15  
16 has been reported extensively (US Department of State, 2018; Lowenstein, 2015),  
17  
18 focus has understandably been put on the ongoing human rights abuses and  
19  
20 dispossession of land by those in power through physical rather than bureaucratic  
21  
22 violence or what scholars in archival studies have argued should be rights in records  
23  
24 for refugees and others who have experienced this kind of abuse (*Carbone et al.*,  
25  
26 *2022; Gilliland and Carbone, 2020*). In accordance with their double-sided nature,  
27  
28 records (official and in other less formal kinds of documentation) and recordkeeping  
29  
30 (administrative, community, family and individual) play central roles not just in the  
31  
32 eradication of the Rohingya people within current Myanmar, as already discussed,  
33  
34 but also in the ability of the Rohingya to seek information about separated, lost and  
35  
36 deceased family members, maintain family and community traditions and knowledge,  
37  
38 (re)claim citizenship and property, actualize civil and human rights, and document  
39  
40 human rights abuses. Official records in the states where Rohingya people are  
41  
42 located may be withheld, physically inaccessible or inaccurate. Those held by the  
43  
44 people themselves, such as identity documents, copies of land deeds, and personal  
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46 papers that provide evidence of their previous lives in Burma and that have survived  
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48 their displacement and current life conditions are fragmented, dispersed and  
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4 endangered in a documentary diaspora that parallels that of the people to whom they  
5  
6 relate. Moreover, and escalating during the Covid-19 pandemic, social media and  
7  
8 other digital communications of Rohingya people that contain additional  
9  
10 documentary traces of their lives, community and homeland have been repeatedly  
11  
12 subject to hacking attacks and disinformation campaigns, including by state actors  
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16 (Beech, 2021).  
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### 23 **Impetus behind the R-Archive and Use of Blockweave Technology**

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26 **Muhammad Noor, a Rohingya himself, founded the grassroots organization, the**  
27  
28 **Rohingya Project, in 2017.** The Rohingya Project employs current and emerging  
29  
30 technologies in a number of different areas to connect the Rohingya diaspora and  
31  
32 protect the rights and interests of Rohingya people. Its goals include to create a  
33  
34 digital ecosystem to uplift and empower stateless Rohingya in diaspora both  
35  
36 economically and socially; to achieve a number of UN Sustainable Development  
37  
38 Goals related to poverty eradication, social marginalisation and sustainability within  
39  
40 the Rohingya community; to come up with a strong Proof of Concept for community  
41  
42 empowerment that can be shared with other stateless and marginalised people; and  
43  
44 to encourage Rohingya diaspora self-organisation and collaboration (**Rohingya**  
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46 **Project, n.d.**).  
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56 A key technology strategy is to create blockchain-based social and financial inclusion  
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58 services catering to the stateless Rohingya diaspora, including the creation of digital  
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4 identities to allow the Rohingya to be able to transition from the informal economy  
5  
6 into the mainstream financial system (Prasse-Freeman, 2020). One initiative is the  
7  
8 development of a tokenized voucher reward system for volunteer work by refugees.  
9  
10  
11 Recognizing the pressing present and potential future documentary and cultural  
12  
13 heritage needs and concerns of this global diaspora, another is to develop the R-  
14  
15 Archive.  
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20 Because of the factors outlined above, there is a heightened awareness of the need  
21  
22 for a digital infrastructure that supports secure creation, transmission, preservation  
23  
24 and accessing of digital copies of all forms of documentation generated or held by  
25  
26 the Rohingya community. The R-Archive is a community-driven effort to identify and  
27  
28 preserve, under as secure and trusted conditions as possible, digital copies of  
29  
30 documents that are of juridical, cultural and personal value to the Rohingya people  
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32 and also of significance as a store of primary source documentary evidence that  
33  
34 might be used by international legal institutions in investigating genocide taking place  
35  
36 in Burma and by academic researchers studying the history of Burma. Its  
37  
38 development is being undertaken in collaboration with technology partners **Datarella**  
39  
40 and the **Rights in Records in Displacement and Diasporas Network (RDDNN)**.  
41  
42 **RDDNN is a worldwide community of scholars, information and cultural**  
43  
44 **professionals, educators, artists and activists, and those who have experiences of**  
45  
46 **displacement, migration and diaspora. It is engaged in an array of multidisciplinary**  
47  
48 **projects that include archival platform development and records systems design, and**  
49  
50 **community and network building (RDDNN, 2022).**  
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4 As already introduced, such kinds of documentation can support individual claims for  
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6 historical citizenship, property ownership, academic and professional qualifications,  
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8 and more. With official records, issuing authorities retain and control one copy, but  
9  
10 individuals or records subjects may hold another copy. These second copies are  
11  
12 what the R-Archive is relying upon to build a preponderance of documentary  
13  
14 evidence that could support Rohingya communities' claims of substantial and  
15  
16 continual historical presence in the state now known as Myanmar, to provide proof of  
17  
18 human rights abuses and genocide, and to challenge the veracity or absence of the  
19  
20 copies of records still held by the state that might have been altered or eliminated.  
21  
22 However, finding such large numbers of surviving documents is a major challenge in  
23  
24 itself. Forced displacement that results in a community diaspora is often used by  
25  
26 hostile governments as a way to eliminate an unwanted population and to prevent it  
27  
28 from remaining culturally robust, as well as to prevent community reorganising and  
29  
30 returning. Removing, destroying and/or discrediting any documentary evidence that  
31  
32 members of that population might produce in order to return, claim rights or seek  
33  
34 reparations is also part of ensuring that those who have been displaced can never  
35  
36 return or claim any kind of political power or social capital. Forced displacement also  
37  
38 makes it difficult and often unsafe to carry physical records, which is why the use of  
39  
40 social media and mobile phones has become so prevalent among certain displaced  
41  
42 populations as a way to store, transport and access documentation. In the case of  
43  
44 the Rohingya, however, very few can afford or even use such technologies and  
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46 within the camps, even having a mobile phone can be enough to get one killed.  
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4 Hence the R-Archive is focused at this point on the collection and digitization of  
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6 copies of physical documents. The R-Archive is thus also an important addition to  
7  
8 other notable efforts in the diasporic community that have attempted to employ the  
9  
10 tools of technology for cultural preservation. These include the introduction of the  
11  
12 Rohingya script into Unicode and the implementation of Rohingya-led online news  
13  
14 channels (Aventurn, 2018).  
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20 In stance and procedure, the R-Archive centres the autonomy of Rohingya  
21  
22 individuals, families and communities with regard to the selection and digitization of  
23  
24 records, the construction of narratives in metadata, accessibility and the delimitation  
25  
26 of access permissions. Seeking to counter the power of the current Myanmar military  
27  
28 regime and its stakeholders and their intent to assert their own particular narrative of  
29  
30 events of the past decade (Aung, 2019), it is intended that the documents to be  
31  
32 preserved in the R-Archive will provide evidence of the reality of extensive and  
33  
34 historical civic participation and cultural connections of the Rohingya people in the  
35  
36 affairs of Burma prior to and after the takeover of the military regime in the 1980s. As  
37  
38 these records accumulate within the archive, collectively they will also highlight the  
39  
40 suffering of the Rohingya people before the removal of their citizenship as well as in  
41  
42 their subsequent statelessness. The types of records to be stored range from those  
43  
44 of a personal nature (such as family photographs and letters) to those that connect  
45  
46 to civic and bureaucratic functions of the Burmese state. Examples of the latter  
47  
48 include family listings, school registration documents, birth records, land and  
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50 property deeds, civic service certificates, and most critically identity documents, such  
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3 as old passports and national identity cards. Of particular note, Rohingya who lived  
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5 in Burma from 1951 onwards may still possess their old green or pink national  
6  
7 registration cards. Following the 1982 Burma Citizenship Law, these were replaced  
8  
9 with temporary white cards that were a first step in rendering the Rohingya  
10  
11 population stateless and also created a barrier to repatriation within Burma for those  
12  
13 who were working or refugees outside the state (Potter, 2019; Holzl, 2018). In many  
14  
15 cases, these cards are the last remaining records that Rohingya refugees possess  
16  
17 that evidence their former residence in their homeland in Rakhine, although many  
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19 such refugees possess no form of documentary proof of their identity at all.  
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### 31 **Developing the R-Archive Pilot**

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34 Beginning in January 2021, the Rohingya Project began work on a pilot for the  
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36 Rohingya Archive. The goal of this pilot was to collect and store examples of a range  
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38 of documents that demonstrate different aspects of Rohingya culture and links to  
39  
40 their homeland as well as those that record formal relationships between members  
41  
42 of the Rohingya community now in diaspora and the Burmese state (e.g.,  
43  
44 acknowledgments of citizenship). The pilot was intended to demonstrate the viability  
45  
46 of using a Blockchain-inspired decentralised archival system combined with a  
47  
48 community-driven approach to data collection, and then to evaluate the results for  
49  
50 potential to scale. The pilot focused on countries hosting significant Rohingya  
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52 populations outside of the main conflict zone in Burma, specifically Bangladesh  
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4 (estimated Rohingya population 1.1 million), Saudi Arabia (estimated population  
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6 300,000) and Malaysia (estimated population 100,000).  
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10 The first phase of the pilot involved Rohingya Project team leaders consulting with  
11  
12 **RRDDN researchers** on the development of a specific methodology for data  
13  
14 collection in order for the archive and its contents to meet, as far as possible, under  
15  
16 the conditions in which the Rohingya community are living, necessary trust and  
17  
18 archival standards that have been established through various archival research  
19  
20 projects and activist initiatives such as InterPARES (n.d.) and Witness (n.d.), as well  
21  
22 as relevant juridical instruments (**Gilliland and Carbone, 2020**) Beyond identifying  
23  
24 documents to be digitised and then entering the digital copies onto the blockchain, it  
25  
26 was also essential to create metadata that captured as much information as possible  
27  
28 about the provenance of the documents and their significance to the individuals and  
29  
30 families to whom they pertained or who had them in their possession. A template  
31  
32 was designed to capture relevant metadata with the idea that it would be completed  
33  
34 in English for each document by Rohingya Project field officers who would be doing  
35  
36 the digitization on the ground, and then both would be uploaded onto the blockchain.  
37  
38 This metadata serves both to capture stories associated with the documents, and to  
39  
40 enhance the evidentiary value of the documents being copied. As will be discussed  
41  
42 later, the research and development team was concerned that the more steps and  
43  
44 people that were involved in the processes of creating the copy and uploading it, the  
45  
46 less trusted those processes and the digitised documents might be when  
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48 subsequently introduced as evidence into juridical processes. Due to the conditions  
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4 in the locations where this work was being carried out, where security and  
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6 infrastructure as well as living conditions meant it was essential to work fast during  
7  
8 moments when there was access to light and internet, where there were personal  
9  
10 safety concerns for those contributing documents and for the field officers, and  
11  
12 where the likelihood of re-finding the person who had the physical document in their  
13  
14 possession to gather follow-up metadata was highly unlikely, it was decided that  
15  
16 metadata collection would also include audio or video recordings of the stories told  
17  
18 by contributors – to the extent that they were comfortable in being recorded. A  
19  
20 protocol for all the necessary steps were then delineated in a field manual guide that  
21  
22 was to be shared with field officers during their training for data collection.  
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30 The next phase was initial technological development, which involved educating the  
31  
32 developers of the digital archive on the Rohingya use case in order to create a set of  
33  
34 specifications that could be adopted within certain resource limitations. Attention was  
35  
36 put on the user journey (in this case the users were considered to be field officers)  
37  
38 for the uploading of data and associated metadata and necessary parameters for  
39  
40 privacy and access of stored documents. This phase coincided with the recruitment  
41  
42 and capacity-building of the field officers who would be responsible during the pilot  
43  
44 development for outreach to members of the Rohingya community willing to allow  
45  
46 copies of documents in their possession to be digitised and uploaded into the  
47  
48 archive. The archive is not designed to have any physical counterpart – the  
49  
50 development team believe, in line with other post-custodial community-based  
51  
52 archives (Caswell, 2021), that it is very important for both legal and affective reasons  
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3 that community members are able to retain the original copies of the documents  
4  
5 themselves, to the extent that they have the ability to do so. For the ease of outreach  
6  
7 and discretion, field officers were selected who were Rohingya themselves and  
8  
9 residing in the target diaspora communities themselves (specifically, in Mecca, Saudi  
10  
11 Arabia; Cox's Bazaar, Bangladesh and Kuala Lumpur, Malaysia). A deliberate  
12  
13 decision was made early on to not do outreach to Rohingya populations residing in  
14  
15 Burma given its status as an active conflict zone.  
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26 Field officers limited their outreach to their surrounding community networks and  
27  
28 were instructed not to openly publicise the R-Archive pilot or reach out yet to broader  
29  
30 sections of the community. This strategy was adopted to address the sensitivities  
31  
32 and safety concerns involved in collection of private documents and recording of  
33  
34 testimonials, and to prevent any potential spread of misinformation regarding the  
35  
36 efforts of the Rohingya Project while not adding to the stresses experienced by the  
37  
38 communities in the wake of anti-immigrant crackdowns by host governments since  
39  
40 the onset of the Covid-19 pandemic. Through an initial survey, a small set of  
41  
42 documents was identified by the field officers for the purposes of the pilot, although  
43  
44 physically meeting with document holders to verify and scan their documents as well  
45  
46 as conduct live testimonials was further complicated due to the prevailing pandemic  
47  
48 and associated economic lockdowns. Since the project is being administered by the  
49  
50 Rohingya Project, the Rohingya field officers were trained to administer and record a  
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3 formal informed consent process as part of the document collection process. In total,  
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5  
6 42 documents were collected, scanned and stored, along with 25 video and audio  
7  
8 testimonials.  
9

10  
11  
12 In parallel with this work on the ground, the project team continued to develop the  
13  
14 technical solution, initially working with an open source blockchain solution that had  
15  
16 been designed to support international real estate transactions. However, as  
17  
18 cryptocurrency spiked in value, working with blockchain moved financially out of  
19  
20 reach of the Rohingya Project and instead a variant on blockchain technology,  
21  
22 Blockweave, was selected for the R-Archive. Blockweave is supported by the  
23  
24 Arweave and is an open, permissionless, decentralised storage network that has an  
25  
26 accessible and sustainable economic model that is more hospitable to not-for-profit  
27  
28 and low budget implementations.  
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### 40 **The Application of Blockweave and Arweave Technology in the R-Archive**

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43 The R-Archive is composed of two main components, the R-Archive web app, and  
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45 Arweave, to which it is connected. The R-Archive web app serves as the user  
46  
47 interface, which allows for the indexing, encryption, uploading, retrieving and  
48  
49 decrypting of Rohingya documents from Arweave's Blockweave. The Blockweave is  
50  
51 an innovative, blockchain-like data structure that offers decentralised, immutable and  
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53 affordable data storage. The Arweave storage technology stack and R-Archive client  
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3 application are used in concert to achieve a technical solution that allows for the  
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6 following R-Archive and document properties:  
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- 9 • *Tamper-proof*: once a document and metadata are uploaded, they cannot be  
10  
11 manipulated.  
12
- 13 • *Secure audit trail*: updates of metadata are recorded along with the unique  
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15 uploader identifier, the public address derived from the private key.  
16  
17
- 18 • *Censorship resistant*: uploaded encrypted documents cannot be deleted by a  
19  
20 single authority.  
21  
22
- 23 • *Always available*: documents stored on a decentralized storage don't face the risk  
24  
25 of server downtime.  
26  
27
- 28 • *Privacy-preserving*: only an encrypted version of a document is stored on-chain.  
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36  
37 This section first touches on how blockchain technologies such as those enabling  
38  
39 Bitcoin or Ethereum provide decentralised and immutable storage, as well as why  
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41 they fail at offering affordable storage, thus creating a paradox for archival  
42  
43 applications; while decentralised/non-custodial and immutable storage can  
44  
45 potentially offer important benefits for archival purposes in terms of securing  
46  
47 archived content and increasing trust in both its reliability and its stewardship  
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49 (Lemieux, 2019; 2017), high costs for storing large data files and environmental  
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51 concerns regarding heat generated by computationally-intensive mining can make  
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53 them prohibitively expensive and environmentally inappropriate for archival and  
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4 preservation applications. The section then lays out the components of Arweave's  
5  
6 technology stack that enable all three previously mentioned characteristics of the R-  
7  
8 Archive: decentralisation, immutability, and affordable storage of its content.

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10  
11 Arweave's Blockweave data structure, transaction process, state update function  
12  
13 (SPoRA consensus mechanism) and AR token economy and perpetual storage  
14  
15 pricing mechanism are described. The final part of this section provides an overview  
16  
17 of the R-Archive web app, illustrating how new files are uploaded, as well as the  
18  
19 encryption method that is used to keep documents private, AR-Token Economy and  
20  
21 perpetual storage pricing.  
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### 31 *Blockchain technologies*

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34 Non-custodial/decentralised storage is achieved by implementing crypto-economic  
35  
36 incentive schemes, which allow an open network of computers, called nodes, to  
37  
38 reach agreement over the state of the network without relying on a centralised  
39  
40 authority. These incentive schemes leverage digital tokens to create games in which  
41  
42 the dominant strategy for each node is to be half honest. Since these networks are  
43  
44 open, everyone can supply hardware to the network, running the blockchain client, in  
45  
46 order to earn rewards in the form of digital tokens such as BTC or ETH (Bitcoin or  
47  
48 Ethereum). The data stored on these blockchains is described as “non-  
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52  
53 custodial/decentralised” since it is stored simultaneously on multiple nodes belonging  
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57  
58 to various entities and no single entity has sole custody over it.  
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4 Immutable storage is achieved by archiving through a data structure made up of  
5  
6 blockchains. New data is submitted in the form of cryptographically signed  
7  
8 transactions. These transactions are verified by full nodes – also called miners – and  
9  
10 organised into sealed blocks. Blockchain networks use state update functions or  
11  
12 consensus mechanisms to agree on which block should be added to the chain. Each  
13  
14 block is linked chronologically to its previous block using cryptographic hash  
15  
16 functions. This results in an immutable data structure, since even the slightest  
17  
18 change in the data of the previous block would result in a completely different hash  
19  
20 value and would break the whole chain.  
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28 Every full node of traditional blockchains, such as Ethereum and Bitcoin, is required  
29  
30 to store the entire history of blocks (Ethereum, 2022.; Bitcoin, n.d.). On the one  
31  
32 hand, this provides a very strong degree of security for data saved on the chain – a  
33  
34 feature that is very attractive for archives needing to ensure and be able to reassure  
35  
36 others that their contents can be trusted. On the other hand, replicating each data  
37  
38 point over each full node on the chain results in very high costs for data storage,  
39  
40 which can be prohibitive for storing larger files such as documents, images or videos.  
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### 50 *Arweave's Blockweave*

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54 By contrast, Arweave's blockchain-like data structure, the Blockweave, allows nodes  
55  
56 to store only an arbitrary part of the total data set. As the term "weave" indicates, the  
57  
58 Blockweave does not have a simple chronological chain data structure. Each block  
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4 in the Blockweave is linked to two blocks, its previous block and a Recall Block – a  
5  
6 randomly but deterministic selected block in the history of the weave (Williams *et al.*,  
7  
8 n.d.). By eradicating the constraint that each data point of the entire blockchain  
9  
10 needs to be replicated over each full node, costs for storage are drastically reduced,  
11  
12 allowing for more affordable storage.  
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17 Similar to traditional blockchains, immutable storage is enabled by Arweave's block  
18  
19 data structure, adding verifiable signed transactions into cryptographically sealed  
20  
21 and linked blocks. Non-custodial/decentralised storage is archived by Arweave's  
22  
23 token economy, which leverages the AR token to incentives individual nodes  
24  
25 worldwide to provide storage to the network.  
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### 34 *Arweave Transactions and State Update Function*

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36  
37 To append data to the Blockweave, a client, in this case the R-Archive web app,  
38  
39 creates a transaction. This transaction can contain any type of data, for example, a  
40  
41 PDF, PGN or MP4 audio-video file. Furthermore, it contains a digital signature of  
42  
43 data elements created with the private key of the message sender. Signing the data  
44  
45 makes it impossible to manipulate any bit of the data element without breaking the  
46  
47 signature - thus making the data element within the transaction immutable. Each  
48  
49 transaction contains the wallet address of the transaction sender by means of which  
50  
51 transactions can always be traced back to their origin. Additionally, it contains the  
52  
53 transaction ID and metadata tags that can be used to identify the transaction in the  
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4 Blockweave, as well as a transaction fee in AR to compensate the storage providers  
5  
6 for the network.  
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9  
10 Once the transaction is created, it is sent to a node in the Arweave network that  
11  
12 validates the transaction and scans it against its content policy. A node's content  
13  
14 policy allows for the rejection of certain types of data that might not comply with the  
15  
16 rules in the jurisdiction in which the node operates (Williams *et al.*, n.d.). Nodes try to  
17  
18 bundle verified transactions into blocks to append them to the Blockweave for which  
19  
20 activity they will be rewarded with AR tokens. Here Arweave's state update function,  
21  
22 Succinct Proofs of Random Access (SPORA), comes into play. SPORA is an  
23  
24 energy-efficient adaptation of Bitcoin's Proof of Work consensus mechanism, which  
25  
26 incentivizes nodes to replicate Blockweave data on their local storage and provide  
27  
28 fast access to it. In order to mine a new block, nodes must find a hash value, which  
29  
30 satisfies the current difficulty of the network. This hash value is derived from two  
31  
32 elements. First, a randomly created input parameter, called nonce. Second, the hash  
33  
34 of a data chunk that nodes need to have in their local storage and containing a  
35  
36 deterministic calculated recall byte from the candidate block (Williams and Berman,  
37  
38 n.d.). The more data from the total weave that a node has accessible in its local  
39  
40 storage, the likelier it is to find a new block. This mechanism incentivizes data  
41  
42 redundancy, since storing of rare data sets of the Blockweave provides nodes a  
43  
44 competitive advantage in the mining process. By repeatedly adding different nonces,  
45  
46 miners are trying to find the hash satisfying the current difficulty. Once a valid block  
47  
48 is found, it is distributed within the network.  
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### *AR Token Economy*

For finding new blocks, nodes are rewarded with the native token of Arweave – AR. Arweave’s token economy holds three potential income streams that reward nodes for adding valid blocks: inflation rewards, instant transaction rewards, and compensations from the endowment vault. At the genesis block, 55,000,000 AR were created. An additional 11,000,000 AR in inflation rewards are gradually released at a decreasing rate dependent on the block height. In addition to inflation rewards, miners earn instant transaction rewards, which are a part of the transaction fee included by the transaction sender. Instant transaction rewards, however, only make a small percentage of the total transaction fee paid. The majority of fees goes into the endowment vault. The third income stream comes from the endowment vault. Miners are only compensated with funds from the endowment vault if the instant rewards plus the inflation rewards are not enough to compensate for the estimated cost of storing blocks. Therefore, the endowment vault mechanism is aligned with the perpetual storing cost model of Arweave.

### *Pricing of Permanent Storage*

Arweave estimates the price of permanent storage by taking today’s price for storing 1 GB for 1h on the cheapest HDD (hard disk drive) available and estimating a perpetual rate of decay. Storage costs have been decreasing by roughly 30% per

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4 year the last 50 years. Arweave anticipates a very conservative 0.5% decrease in  
5  
6 storage costs (Arweave, n.d.). Therefore, the price of a transaction equals the size of  
7  
8 the transaction times the estimated cost of storing perpetually. Transactions,  
9  
10 however, are not priced in US dollars but in AR, whose price is volatile in relation to  
11  
12 the US dollar. The current Arweave software release (2.5) relies on a dynamic  
13  
14 difficulty-based price estimation. Thus, the amount of AR that needs to be paid to  
15  
16 miners for including transactions in the Blockweave depends on the current difficulty  
17  
18 of the network. Difficulty is based on the hash power of the network and adjusted  
19  
20 roughly every 50 blocks (Arweave Team, 2021). The more miners who join the  
21  
22 network, the higher the hash power. The higher the hash power, the higher the  
23  
24 purchasing power of AR needs to be in order for miners to afford the cost of storing.  
25  
26 This is why the pricing for permanent storage is not based on USD, which might lose  
27  
28 value over the next decade, but rather it is derived from the purchasing power of AR  
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30 for hardware and its maintenance (e.g., electricity and labour), as represented by the  
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32 hash power of the network.  
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### 47 *The R-Archive Web App*

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50 Between September 2021 and January 2022, **Datarella GmbH** developed the  
51  
52 Minimum Viable Product (MVP) of the R-Archive client application. The React Native  
53  
54 web app allows the Rohingya project team to index and preserve collected  
55  
56 documents on the Blockweave. Core features of the Rohingya Archive are the  
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3 encryption/decryption and upload/download of documents and their related metadata  
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5 files.  
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9 The process starts with user authentication using a private key file. After uploading  
10 the private key file, the R-Archive client downloads, decrypts and displays decrypted  
11 metadata documents of documents that were uploaded using the same key file. The  
12 upload of documents takes place in two separate transactions – a data transaction,  
13 which contains the selected document file, and a metadata transaction, which  
14 contains a JSON file describing key attributes of the document. The metadata  
15 transaction is linked via the data transaction's transaction ID. By separating the  
16 uploading process into two transactions, metadata can be updated by simply  
17 appending a new metadata transaction. Due to the nature of the Blockweave, an  
18 audit trail of metadata transactions is automatically created. Both transactions are  
19 encrypted over the private key using AES256-GCM authenticated encryption. This  
20 ensures that the actual document, which might hold sensitive or private information,  
21 is never uploaded to the Blockweave. Without the private key, the data packages  
22 stored on-chain are unreadable.  
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## 50 **Archival and Evidentiary Considerations and Concerns**

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53 Operating at the intersection of a humanitarian imperative, cultural preservation,  
54 emergent technology and inter-jurisdictional legal considerations and needs, the R-  
55 Archive has surfaced a number of archival and evidentiary considerations and  
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3 challenges from the perspective of archives and recordkeeping. These can be  
4  
5 divided into four overlapping areas: multiple facets of trust, evidentiary requirements,  
6  
7 privacy and safety concerns, and costs and the sustainability imperative.  
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12 The concept of trust has a particular and much-debated history in archival thought  
13  
14 (MacNeil, 2000), one that is grounded in notions of institutional authority,  
15  
16 accountability and transparency that presuppose a records-creating institution that is  
17  
18 both well-functioning (with appropriate checks and balances built into its record-  
19  
20 making and -keeping) and benign (acting in good faith and in the interests of an  
21  
22 undifferentiated populace), and a trusted records preservation institution (usually an  
23  
24 archive) that either takes custody over inactive but still valuable records, or stewards  
25  
26 them within a post-custodial paradigm. The records-creating institution is expected to  
27  
28 produce and manage records that are reliable and usable by its constituents, and the  
29  
30 records preservation institution is supposed to apply appropriate practices to ensure  
31  
32 that the records in its care are authentic – that is, that they remain unaltered from  
33  
34 when they were accessioned or ingested into the archive, or, in the case of digitally-  
35  
36 born records, that the archive has the capacity to generate an authentic copy of a  
37  
38 digital original (InterPARES.org, n.d.; InterPARESTrust.org, n.d.). The archive  
39  
40 usually cannot, therefore, guarantee that the records it is preserving unchanged from  
41  
42 when they were accessioned or otherwise came under archival control are reliable,  
43  
44 unless it has been able to advise or audit records creators regarding the creation and  
45  
46 maintenance of reliable records. It should, however, be able to vouch for the  
47  
48 authenticity of any records that it itself produces in response to a query or need. It  
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4 would then be up to any person or body that introduces that archived record into a  
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6 legal or bureaucratic proceeding to substantiate the degree to which its evidentiary  
7  
8 capacity could be trusted.  
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12 The R-Archive functions in a similar vein, ingesting copies of records that in their  
13  
14 form as well as through their accompanying metadata attest to the degree to which  
15  
16 they may be viewed as reliable. The storage of encrypted digital copies of those  
17  
18 records using Blockweave and the sequential nature of the blockchain-based  
19  
20 approach that makes any alterations due to hacking or technical malfunctions as well  
21  
22 as attempted privacy intrusions immediately apparent offers a strong guarantee of  
23  
24 authenticity.  
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30  
31 Nevertheless, there are important procedural and community issues that also must  
32  
33 be addressed with regard to trust at the R-Archive **that move beyond what can be**  
34  
35 **addressed through the informed consent process that is in place.** Firstly, the  
36  
37 Rohingya people have to trust those who are collecting and archiving copies of their  
38  
39 records. This immediately raises two key questions: Can the archive and its  
40  
41 procedures demonstrate trustworthiness to its expected contributors and  
42  
43 beneficiaries? Although founded and largely operated by Rohingya people, what  
44  
45 (re)assurances can be offered to a population whose previous engagements with  
46  
47 official records and recordkeeping systems may have been characterised by  
48  
49 bureaucratic violence? Sustained relationship-building and outreach within Rohingya  
50  
51 community locations to promote the R-Archive is more likely to be possible where  
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4 Rohingya people are settled in other countries, but for those in refugee camps, it is  
5  
6 much more challenging and is aggravated by the ongoing disinformation campaigns  
7  
8 and other forms of state-sponsored digital disruption to which the Rohingya people  
9  
10 are regularly subjected. Thus differentiating the R-Archive from a complex and  
11  
12 hostile digital information landscape is a significant challenge. Explaining the  
13  
14 disembodied nature of a distributed digital archive, what it seeks to achieve, and how  
15  
16 it will be secured is not easy under optimal conditions and even harder in a  
17  
18 community where there people have suffered under recordkeeping regimes and may  
19  
20 not trust authority. Similarly with the process of asking people to come forward, often  
21  
22 in front of other community members in a crowded camp, with whatever precious  
23  
24 documents they might have in their possession and give them to someone else to  
25  
26 digitise while their own stories about the documents are being recorded, requires a  
27  
28 high degree of trust. At the same time, it is ethically imperative to try to ensure that  
29  
30 those who might potentially contribute documents are as informed as possible, feel  
31  
32 no coercion to contribute and suffer no adverse consequences for having done so.  
33  
34  
35 Although the R-Archive tries to collect provenance information and personal stories  
36  
37 about the records being copied, in reality it is very difficult, in the moment, to verify  
38  
39 such metadata. Moreover, field officers working with the pilot implementation  
40  
41 process quickly found that it was impossible to complete all the required metadata  
42  
43 fields in the midst of the digitization interaction. There are multiple reasons for this.  
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45  
46 Records that were presented to them not only might be in a condition that made  
47  
48 them very difficult to read, but also could be written in one or more of any number of  
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3 languages, including English, Burmese, Rohingya and the languages of the location  
4  
5 in which displaced Rohingya communities are now located. Although the field  
6  
7 officers have tried for the purposes of the pilot to locate and become more familiar  
8  
9 with the record types that they are most likely to encounter, reading and extracting  
10  
11 metadata from damaged records or other types of documentation may require much  
12  
13 more careful study or even an expert. Names of individuals and of places may also  
14  
15 vary according to the language and cultural or bureaucratic practices of those who  
16  
17 created or filled out the record. Procedurally, the metadata collection template  
18  
19 requires that key fields taken from the documents are translated into English – a  
20  
21 design decision made after some discussion as the best current option for supporting  
22  
23 future global access by community members in diaspora and scholars who may no  
24  
25 longer, or may not speak, the languages of the documents. It was also felt that this  
26  
27 would best support linkage and compilation among documents within the R-Archive  
28  
29 and with Rohingya documentation external to it. The metadata collection template  
30  
31 also takes time to complete thoroughly – time the field officers found they did not  
32  
33 have when they were working with the individuals to bring forward the original  
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35 documents.  
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49 To address this, the team decided to reduce the amount of the metadata template  
50  
51 that needs to be completed by the field officers and leave it for a dedicated metadata  
52  
53 person to later examine and translate the digitised document, listen to the recorded  
54  
55 testimonial, and then complete the required metadata before uploading it to the  
56  
57 Blockweave. This two-step process unfortunately however, while it supports the R-  
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4 Archive's cultural preservation function by providing as much information as possible  
5  
6 about the documents being included as well as the stories associated with them,  
7  
8 potentially diminishes its evidentiary function. In addition to the challenges that might  
9  
10 already be anticipated as to the reliability of the original documents, their chain of  
11  
12 custody since creation, their physical condition, and the procedures used during the  
13  
14 digitization and uploading of the copies to Blockweave, the inclusion of more steps,  
15  
16 time and people into the digitization and uploading process might be viewed in legal  
17  
18 settings as adding more points at which the evidentiaryness of the document could  
19  
20 have been compromised (Witness.org, n.d.). One potential strategy to counter this  
21  
22 that the team has discussed would be to have both a lawyer and a trusted Rohingya  
23  
24 elder present during the process of interviewing the document holder and then  
25  
26 digitising the document. These legal and community authorities could then provide  
27  
28 written attestations as to the reliability of the document and the digitization process. It  
29  
30 is clear that conditions in some of the refugee camps would make such a strategy  
31  
32 very difficult to implement, but it might be viable in other Rohingya contexts where  
33  
34 the Rohingya have more stable living conditions and perhaps a community centre  
35  
36 might be available to use for the document and metadata acquisition processes.  
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49 Beyond the community-oriented focus of trust-building, questions of trust in records  
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51 by governments in the various locations where there are Rohingya communities and  
52  
53 by international agencies and economic entities are also pressing. Archival  
54  
55 theorisations of trust and trustworthiness have not adequately contemplated the  
56  
57 circumstances routinely faced by displaced persons in which hostile governments -  
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4 at home and abroad - and under-resourced aid agencies lack the capacity,  
5  
6 knowledge or desire to consider records produced by those who have been  
7  
8 displaced in good faith. The benchmarks proposed for authentic and reliable records  
9  
10 generally assume a neutral, fair reception by those inspecting the records, which is  
11  
12 not a given in the circumstances in which Rohingya people's records are likely to be  
13  
14 presented. This situation is further compounded by the variety of juridical contexts  
15  
16 within which these records might be operationalised as proof: each country, state or  
17  
18 agency will have its own pre-requisites for what constitutes 1) a valid form of  
19  
20 documentary evidence and 2) an acceptable digital surrogate of such evidence. With  
21  
22 limitless possible requirements for evidentiality, the R-Archive must attempt to  
23  
24 anticipate the future possible uses of the records being digitised, and balance those  
25  
26 against the amount of technological, documentary and testamentary assurances that  
27  
28 can realistically be afforded by the system, procedures and resources of the archive.  
29  
30 Rich metadata and recorded attestations from community leaders contribute to a  
31  
32 preponderance of evidence that may nevertheless always be open to question. In  
33  
34 the end, however, it may be that, as was the case with the archives developed at the  
35  
36 Hague by the International Criminal Tribunals for Rwanda and the former  
37  
38 Yugoslavia, it is the volume of evidence accumulated within a trustable archive  
39  
40 rather than the reliability of individual documents that best supports Rohingya claims  
41  
42 to citizenship and property rights or claims of human rights abuses and genocide. If  
43  
44 so, then the trustworthiness of the Blockweave application as well as accelerated  
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3 efforts to digitise and upload as many records as possible have to be the priorities for  
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5  
6 the continuing development of the R-Archive.  
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9  
10 Questions about trust are also exacerbated by some of the technological features of  
11  
12 the R-Archive, and the team continues to investigate mechanisms for addressing  
13  
14 them. One of the great benefits of using a Blockweave solution is that the content  
15  
16 can be added, and accessed, from anywhere in the world. This feature supports the  
17  
18 R-Archive's intended function as a community archive and cultural and scholarly  
19  
20 resource. However, regardless of the technology being used, and similar to the  
21  
22 issues already discussed regarding procedures for creating metadata and uploading  
23  
24 content onto the Blockweave, an archive that is widely accessible is less likely to be  
25  
26 trusted in juridical proceedings than one where only Rohingya lawyers can access it.  
27  
28 Questions also arise about how or the extent to which a distributed and immutable  
29  
30 archiving technological structure where content cannot be eliminated and cannot  
31  
32 easily be compartmentalised can meet regulatory privacy requirements as well as  
33  
34 aspirations to the right to be forgotten?  
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44 An overarching concern is that the hardware, internet access and technical  
45  
46 knowledge needed to participate in such an initiative can not only be prohibitive in  
47  
48 cost, but quite simply unavailable in certain refugee contexts. Blockweave addresses  
49  
50 some of these barriers and the dangers of highly volatile crypto developments, as  
51  
52 has been delineated above, but does it go far enough? Sustainability and  
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54  
55 permanence are a perpetual concern for archives and central to their mission.  
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4 Blockweave's economic model is based upon long-term projections of costs, but will  
5  
6 the technology stay around or be migratable to new technologies that may emerge?  
7  
8 Will quantum computing have the capacity to crack the encryption and rupture the  
9  
10 security of the R-Archive? And who, for a community-led and operated archive,  
11  
12 should be the archivists who steward the R-Archive into the long-term future and  
13  
14 champion its evidentiary capacities?  
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### 23 **Conclusion: Reflecting on the Future Development and Potential of the R-Archive**

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27 As this article has laid out, parallel to the physical violence that has been directed by  
28  
29 Myanmar against the Rohingya people is a campaign of documentary force –  
30  
31 including misnaming the Rohingya in the census and the replacement of national  
32  
33 registration cards with temporary identity cards – that supports Rohingya extrusion  
34  
35 from the state through their erasure in the state's archive and reclassification in the  
36  
37 state's recordkeeping systems. While the genocide continues, the worldwide  
38  
39 Rohingya diaspora, and community-led and operated initiatives such as the R-  
40  
41 Archive work to resist the documentary erasure of Rohingya personhood, citizenship,  
42  
43 rights and culture and the potential loss of personal records held by refugees by  
44  
45 building a base of documentary evidence that could be used in prosecutions, redress  
46  
47 actions and community heritage preservation.  
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56 The R-Archive blockchain-inspired design is technologically novel. While  
57  
58 blockchain's affordances of decentralisation and authentication continue to see this  
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3 technological approach extended into new record-making and keeping applications,  
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5  
6 its environmental footprint and financial sustainability are increasingly questioned.  
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8  
9 Inspired by blockchain's characteristics of decentralisation and immutability,  
10  
11 Arweave's Blockweave data structure addresses these concerns by offering secure  
12  
13 data storage at lower cost and lower energy use by means of the data structure,  
14  
15 transaction process, state update function, token economy and perpetual storage  
16  
17 pricing mechanism described above. As the R-Archive research and development  
18  
19 team further tests this approach against the realities of Rohingya documentary  
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21 needs and economic concerns, it will continue to give keen consideration to the  
22  
23 financial and environmental implications of Blockweave as well as its potential to  
24  
25 serve as a model for archival and recordkeeping applications by other communities  
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27 that have experienced oppression, dispossession and disempowerment by means of  
28  
29 bureaucratic violence, and inability to preserve their own physical and digital records  
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31 securely and without incurring risk to their personal safety. **The research team has**  
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33 **been contacted by a number of other interested communities and initiatives,**  
34  
35 **particularly those who are involved in trying to build archives and memory projects**  
36  
37 **for different displaced, diasporic and at-risk communities that are facing similar**  
38  
39 **constraints and challenges. In this respect, it is our hope that not only the**  
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41 **Blockweave technology being employed offers a potential model, but also the**  
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43 **community trust development and metadata gathering protocols that are being**  
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45 **developed for the R-Archive.**  
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4 The parallels between the distributed nature of the community and the distributed  
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6 technology it is marshalling underscore that such an archive can and indeed ethically  
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8 should be community-based and participatory in nature not just in terms of the  
9  
10 accumulation of a collection, but also in terms of its infrastructure (Woodward, 2016;  
11  
12 Gilliland and McKemmish, 2015). The research team is investigating how to push  
13  
14 this participatory ethos even further by examining the potential of Rohingya people in  
15  
16 diaspora owning and operating the computing power that makes the R-Archive  
17  
18 possible. This might potentially even lead to the development of a financial model  
19  
20 that would compensate Rohingya blockweave miners and thereby directly contribute  
21  
22 to economically sustaining and advancing a community where dispossession and  
23  
24 financial precarity have been characteristic since targeting by the state began. Again,  
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26 this is an aspect that shows great promise for other communities facing financial  
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28 precarity.  
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38 While these prospects are compelling, the R-Archive development and testing  
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40 highlights many ways in which the archival problems surfaced are tricky complexes  
41  
42 of technical, legal, social and affective factors; and that technology affordances alone  
43  
44 cannot solve informational or recordkeeping challenges. The procedures that have  
45  
46 been refined through the R-Archive pilot for the capture of digital surrogates place  
47  
48 the person and community at the centre of the relationships between records, rights,  
49  
50 legal systems and the archive in ways that can challenge more traditional archival  
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52 thinking and practices, and it is expected that procedures yet to be developed for  
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54 accessing the future archive will do the same. The next phase planned by the  
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4 Rohingya Project will be to scale up the current archival operations to a wider reach  
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6 by mobilising key partners within the Rohingya community. The research and  
7  
8 development team will also further refine the digital archiving process to allow for  
9  
10 easier categorization of documents and filtering tools to be introduced. The results of  
11  
12 the pilot are being shared with invited experts in archival studies, international law  
13  
14 and international development sectors for feedback on how to improve the  
15  
16 procedural and technical aspects to meet archival and legal requirements and  
17  
18 ensure that processes are implementable under field conditions. In this regard,  
19  
20 privacy and personal safety, information security, and rights to withdraw materials  
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22 from the archive are all important considerations, as well as challenges around trust,  
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24 evidentiality and sovereignty that have been raised in this article.  
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33 To conclude, a complex set of interconnecting considerations are raised by this use  
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35 of emerging technologies in service to a vulnerable and diasporic community, and  
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37 hostile governments and volatile cryptocurrencies are both threats to the distributed  
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39 post-custodial R-Archive. However the strength of the community bonds that form  
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41 the archive and are articulated in its records speak to the possibility of perdurance  
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43 for a global Rohingya archive, and working through the challenges surfaced by its  
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45 development offers the possibility to serve as a model that might be adaptable for  
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47 other grassroots archival activist projects initiated by oppressed, marginalized and  
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49 diasporic communities.  
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