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Ana Valdivia

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The *supply chain capitalism of AI*: a call to (re)think algorithmic harms and resistance through environmental lens

Ana Valdivia [a,b]

[a]Oxford Internet Institute (University of Oxford), Oxford, UK; [b]UCL Centre for Capitalism Studies, University College London, London, UK

ABSTRACT

Artificial Intelligence (AI) is woven into a supply chain of capital, commodities and human labour that has been neglected in critical debates. Given the current surge in generative AI – which is estimated to drive up the extraction of natural resources such as minerals, fossil fuels or water – it is vital to investigate its entire production line from a critical infrastructural perspective. Drawing on *the supply chain capitalism*, a concept coined by Anna L. Tsing in 2009, this paper contributes to critical AI studies by investigating the structure of AI supply chains, taking into account the mining, electronics, digital and e-waste industry. This paper illustrates how the supply chain capitalism of AI is precipitating geographical asymmetries connected to contested struggles in México by focusing on a key element of these chains: data centres. In times of climate emergency, this paper calls to reconsider algorithmic harms and resistance by investigating the entire capitalist production line of the AI industry from critical and environmental lens.

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> 'Contexts in which, under the paradigm of progress characterised by the rationalisation of life, industrialisation of the economy, urbanisation of the population, and commodification of nature, there is an incentive for the fragmentation of the latter for its exploitation, objectification, and appropriation. All of this serves as a trigger for a development model no different from that underlying the role of Latin America in the historical geography of accumulation, as a supplier of raw materials, leading to environmental injustice and power inequality'. (Romero, 2021, pp. 414–415)

1. Introduction

'We walk for the water we need. If we don't walk, who will give it to us? If we don't show up in Querétaro, there's nothing to gain here, so let's see if we win the water…We used to draw water from a well, and it dried up. It's gone. It doesn't yield anymore. Since last year, there hasn't been rain, and this year is the same…Then the mine harmed us. The water

CONTACT Ana Valdivia ana.valdivia@oii.ox.ac.uk Oxford Internet Institute (University of Oxford), 34 St Giles, Oxford, UK

got used up, and now there's nothing. If you don't carry it, there's nothing. So, in total, it's a 4 hours journey each day to fetch water. Those who can take about 10 litres; those who can take more about 20 litres; and those who can't, nothing. Well, there [in our community], we are used to planting beans, preparing nixtamal[1], and using that water for irrigation. Then you have to wash the dishes, and it's done, you have to go for another water trip'.[2]

Juan is a middle-aged man born in the Indigenous and rural community of Maconí within Querétaro (México) and the author of the previous quote. I met him during the protest organised by the community of Maconí – together with other communities – in front of the city hall of the capital of Querétaro. Within this protest, these communities demanded the fundamental right to access water. At the same time of this protest, during October 2023, Querétaro is becoming the location of the largest data centre hub in Latin America. This region is already hosting 10 operational data centres with plans to install a further 18 data centres more, some of them to support the growing demand of Artificial Intelligence (AI).[3] In this region, data centres together with other industrial activities are extracting drinking water – which is used as a commodification of nature– for their economic activities. Given that Querétaro's capital is experiencing water scarcity, the industrial parks of the capital could be supplied with water resources from Maconí in the future.

The literature on algorithmic harms (Diberardino et al., 2024; Valdivia et al., 2024) and resistance (Heemsbergen et al., 2022; Velkova & Kaun, 2021) has largely analysed the political impact of algorithmic systems. However, infrastructural harms driven by supply chains of AI have been overlooked. As the previous case illustrates, data centres – which are considered a key aspect within the supply chains of AI – can also provoke other type of harms and resistance that are also connected to AI (Brodie & Velkova, 2021; Hogan, 2015; Lehuedé, 2022; Monserrate, 2022). In fact, AI's innovation is tied to material infrastructure and economic ecosystem often obscured in critiques towards this technology (Mills, 2024; van der Vlist et al., 2024). The development of advanced AI products by industrial and economic elites relies on a supply chain capitalism that 'creates both great wealth and great poverty' (Tsing, 2009, p. 171). This paper illustrates that AI-based products, such as ChatGPT, are built on a supply chain of minerals such as silicon or tantalum extracted to manufacture chips and wires that in turn powered AI-based data centres where these algorithms are trained and deployed. The AI industry is driving up the number of data centres that are going to be built to satisfy the seemingly insatiable demand for its products, such as ChatGPT (Rogers, 2023). This implies that more minerals will be extracted to manufacture semiconductors, that in turn will use more energy and water. If left uncontrolled, this economic growth based on AI products will entail environmental struggles in the territories where the supply chain of AI is already operating.

The contribution of this paper is motivated by the research question *what do we see if we look at the supply chain capitalism of AI?* The paper moves into the theoretical framework by presenting the supply chain capitalism of AI (Tsing, 2009). It illustrates that the supply chain of AI is a complex, global and opaque mechanism that extracts, produces and distributes components that are key for the making of AI nowadays. Then, the paper presents an empirical case study gathered during three months of fieldwork in México – related to Juan's testimony – that unveils how supply chain capitalism of AI

is reproducing social and environmental struggles. In this case, data centres are extracting water in a region that is suffering severe droughts and where people do not have access to water in their own houses. This piece offers a theoretical and empirical analysis aimed to analyse how supply chains of AI are impacting in local communities and territories. The paper concludes that critical AI studies should investigate other types of harms and resistance arised within the supply chain capitalism of AI. In times of climate emergency, it is fundamental to investigate how the AI industry is reproducing other types of harms related to fundamental rights such as the access to water.

2. What makes AI possible today from an infrastructural perspective? Mines, chip factories, data centres and e-waste dumps

The operational aspect of AI infrastructure depends on a large number of materials, commodities and resources that are entangled in global supply chains (Cox & Wartenbe, 2018). Global supply chains are the processes 'by which a capitalist enterprise organises the commodification process by dispersing each element to geographic locations that optimise labour costs, access to raw materials, or proximity to markets' (Dyer-Witheford, 2015, p. 83). In the case of AI, these supply chains entail several industries such as mining, electronics or data centres. In the case of mining and electronics, the media ecologist scholar Taffel (2019) claims that: 'the flows of matter and energy which transform ores, earths and fossil fuels into assemblages of digital microelectronics involves a multiplicity of materials' (p. 161). In the case of data centres these digital microelectronics are housed and stored within racks – the cabinets containing servers that process data. To train sophisticated algorithms such as large linguistic models (LLMs) data centres need to be equipped with Graphic Processing Units (GPUs). GPUs are mainly made of silicon and copper, together with tantalum, aluminium, or tungsten which are extracted from different territories across the globe (Bobba et al., 2020; Euromines, 2020). Electronics such as GPUs have an average lifespan of 5 years,[4] so data centres discard electronics generating a huge volume of e-waste – which could be considered the last stage of this supply chain. Some materials are recuperated and reintegrated supply chains. However, a large volume of electronics end up incinerated or dumped in e-waste landfills, often across the Global South (Gabrys, 2018; Taffel, 2019).

Global supply chains are political elements that reproduce oppression and social inequalities by 'proliferat[ing] difference within structures of economic power, grow [ing] the gap between rich and poor and genera[ting] varied forms of hierarchy and exclusion' (Neilson & Rossiter, 2021, p. 107). In the specific context of supply chains for technology, the critical literature has demonstrated that the contested nature of global supply chains of digitalisation is related to environmental and labour struggles (see for instance *Technoprecarious* (Precarity Lab, 2020), *Cobalt Red* (Kara, 2023), *Cyber-Proletariat* (Dyer-Witheford, 2015) and *On New Terrain* (Moody, 2017). As this paper will show, the supply chain of AI is not an exception. Supply chains and their logistics infrastructure are connected to extractive industries that operate throughout the commodification of nature in order to produce surplus and capital (Cowen, 2020; Mezzadra & Neilson, 2019). More precisely, in relation to digital infrastructure, Taffel (2019) articulates that 'each stage in the life cycle of microelectronics is entwined with ethical

imperatives regarding social and environmental justice' (p. 161). Taking this further, the supply chain of AI – which is intertwined with the lifecycle of microelectronics – also reproduces social inequalities and environmental harms (Kara, 2023; Yeung, 2022).

Although one might think that the supply chain of AI is equal to the supply chain of electronics, the supply chain of AI entangles other type of industries such as data centres, data labelling companies or big tech firms together with the electronic industry. Within this supply chain, there are different infrastructural elements that are key in the context of the making of AI. On one hand, mines, chips factories, data centres and, e-waste dumps are key elements of the supply chain that manufacture products necessary for AI such as semiconductors, servers and wires, amongst others. On the other hand, the digital industry which comprises software companies and data labelling firms are also part of the AI supply chain. They design algorithms, create and curate datasets needed to fit AI systems.

Each of this infrastructural element of the supply chain has been studied in the critical literature regarding its political and environmental impact, demonstrating that the supply chain of AI transforms territories, disrupt the ecosystem and create frictions within local communities (see Acosta et al., 2020; Adamovic et al., 2021 for mineral extractivism; Yeung, 2022 for supply chains of electronics; Brodie, 2020 and Yeung, 2022 on supply chains of data centres; see Brodie, 2023; Fogaty & Sophia, 2023; Njoku et al., 2023 for e-waste dumping; and see Widder, 2023 for AI supply chains). In fact, there is a large body of literature within critical infrastructure studies that has separately investigated the environmental struggles that digital infrastructure generates (Brodie & Velkova, 2021; Hogan, 2015; Lehuedé, 2024; Monserrate, 2022). Data centres are considered an energy and water-intensive industry to keep their servers on and cold 24h/7 and 365 days every year (Fogaty & Sophia, 2023). The carbon and water footprint of this infrastructure is massive as revealed by several researchers (Hogan, 2015; Li et al., 2023; Libertson et al., 2021; Luccioni et al., 2023; Monserrate, 2022).

The increasing demand for AI services is driving up extraction for more minerals, energy and water, a trend that is expected to escalate in the incoming years. As a consequence, some data centre projects have recently faced resistance by local communities who were against their construction. For instance, the grassroots organisation *Tu Nube Seca Mi Río* (Your Cloud Dries My River) is building resistance efforts against a Meta data centre to be installed in a rural area near the Tajo river in Spain.[5] The political and environmental impact of mines excavating minerals used for manufacturing electronics have also been the focus of investigation in the literature demonstrating the negative consequences that extractivism has on the environment (Aguilar Gil, 2023). A recent study by Owen et al. (2023) highlights that a large proportion of minerals – such as such as cobalt, tungsten or copper – that are essential for electronics like GPUs – are extracted from Indigenous and peasant lands. In fact, this study reveals that 62% of these mine projects – which extract vast amounts of water – are placed in lands with high drought risks. The materials impact of AI's end-of-life – which generates e-waste – also entails serious perils for the environment. Although some components are sometimes recovered, electronics disposal involves hazardous elements such as mercury, arsenic and lead seeping into the water and soil, posing significant environmental and health risks (Akese & Little, 2018; Gabrys, 2018; Taffel, 2019).

Yásnaya Elena Aguilar Gil, a linguistic and *mixe*[6] activist, has advised about the material struggles that AI industry is originating, joining other critical Latin American voices (Ricaurte, 2019; Romero, 2021). She has raised questions over this industry that are critical of the amount of natural resources needed to train and deploy algorithms such as ChatGPT:

> 'While in the metropolis the development of AI, new technologies and systems such as ChatGPT are celebrated and open debates, here other questions arise: how much more extractivism can the peoples and territories, which have historically been exploited as quarries of the world, sustain the growing demand for minerals required by new technologies?' (Aguilar Gil, 2023).

In this vein, Aguilar Gil interrogates the impacts that AI supply chains have on territories and communities by questioning how this industry extracts natural resources from local and Indigenous communities. As this paper illustrates, the data centre industry in México is instrumentalising the commodification of water for cooling down their serves while making profit. At the same time, the community of Maconí, situated at 150 km distance is suffering water scarcity.

3. The supply chain capitalism of AI

Supply chain capitalism is a theoretical framework proposed by the anthropologist Tsing (2009) that refers to 'commodity chains based on subcontracting, outsourcing, and allied arrangements in which the autonomy of component enterprises is legally established even as the enterprise are disciplined within the chain as a whole' (p. 148). Tsing proposes this conceptual approach to show the heterogeneity of contemporary global capitalism and illustrate how diversity is a key point in the distribution of capital, labour power and resources across supply chains. In this essay, she exposes the diversity and hierarchy in labour of supply chains of firms such as Wal-Mart or Nike. Tsing (2009) argues that some companies rely on supply chains that 'depend on firms that break not just national laws but also every conceivable humanitarian and environmental standard' (p. 172). Throughout this essay, Tsing (2009) invites us to stay 'politically close to supply chain hierarchies' and shed light on how exploitation becomes possible through classism, sexism and racism (p. 172). Therefore, I take this invitation to propose a close-proximity study of the supply chain capitalism of AI and examine contemporary global capitalism through the logistical chains of its infrastructure.

3.1. Mining and GPUs manufacturing

The supply chain capitalism of AI is the orchestration of commodity chains that extract, ship, and manufacture the natural resources needed to develop AI from an infrastructural perspective, such as mines, data centres and e-waste dumps together with their human resources (miners, drivers, directors of data centres operations, e-waste dismantlers, etc.). Within this chain, digital elements such as datasets and algorithms together with human labour (data annotators, data scientists, data engineers, etc.) are also key

elements in the supply chain of AI (see Figure 1). A close examination of the supply chain of AI starts by focusing on NVIDIA, the global chip designer.[7] While its business model focuses both on software and hardware infrastructure, its key product are GPUs. However, NVIDIA does not manufacture most of these electronics but 'utilise a fabless[8] manufacturing strategy, whereby [they] employ key suppliers for all phases of the manufacturing process, including wafer fabrication, assembly, testing, and packing' (NVIDIA, 2022, p. 4).[9] While GPUs were originally designed for video rendering in computer games, these semiconductors have become relevant in the AI industry given their power to process information parallelly, allowing matrices operations – that are key for algorithmic training – in less time than previous semiconductors. A report published by Euromines shows that GPUs are made of large variety of minerals but silicon and copper are the main ones – amongst gold, tantalum, palladium, boron or tungsten (Euromines, 2022).[10] The dependence of these electronics on numerous minerals implies a global logistical chain orchestrated for mining extractivism (Taffel, 2019). In other words, companies like NVIDIA collaborate with a multitude of mining, smelting and refining companies around the Globe to source minerals from various regions. In fact, the Conflict Mineral Report of NVIDIA clearly illustrates that they obtain gold, tantalum, tin and

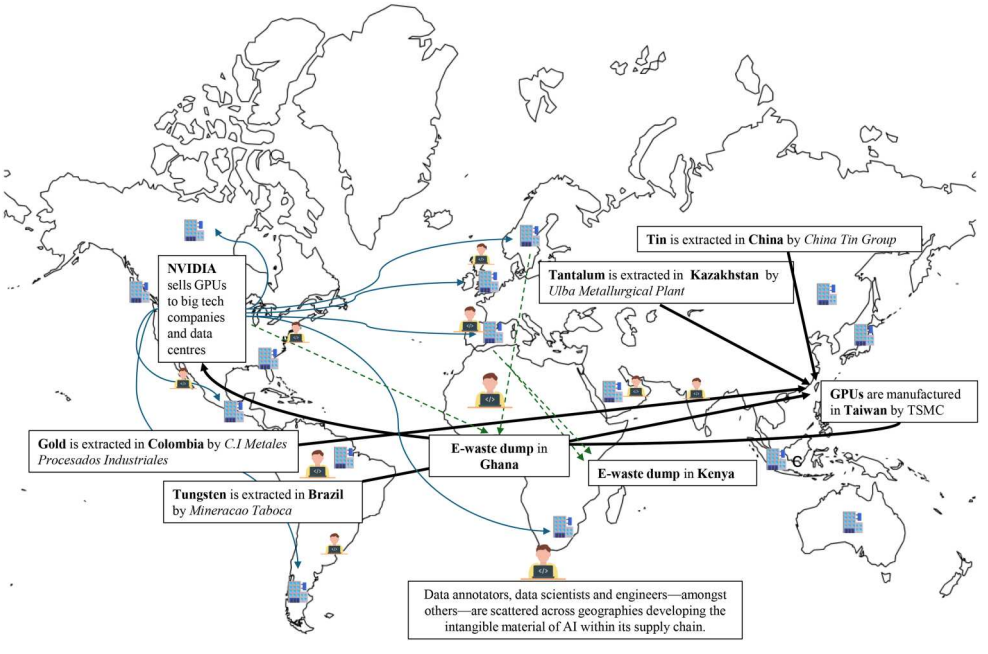

Figure 1. The supply chain capitalism of AI. This image partially captures the supply chain of AI as a global and complex phenomenon. Natural resources, components and materials to build AI infrastructure are extracted, shipped, manufactured and produced across the globe. For instance, NVIDIA obtains tungsten from Brazil; gold from Colombia and tantalum from Kazakhstan. Minerals are assembled to manufacture GPUs by TSMC. NVIDIA sells GPUs across data centres in the world. Given the refresh rates of these materials, data centres sent their components to recycle plants or dumps. The human labour wrapped-up in this chain includes, data labellers, logistics drivers, data scientists, miners, data centre operators and electronic waste dismantlers, who are also scattered across different geographies. Source: NVIDIA (2022) and fieldwork.

tungsten from 259 companies across Asia, Africa, North America, South America, Europe, and Australia (NVIDIA, 2022). Therefore, mine companies are key allies in the supply chain capitalism of AI by extracting minerals. However, NVIDIA does not manufacture GPUs directly. This service is heavily outsourced to the Taiwan Semiconductor Manufacturing Company (TSMC), which is considered the world's largest chip manufacturer, as part of a strategic partnership between NVIDIA and TSMC reaching back to 1998. This explicit collaboration between both companies reflects the continent-crossing scale of the supply chain capitalism of AI. Moreover, NVIDIA is collaborating with other firms within the semiconductor space rather than computing. For instance, NVIDIA announced a collaboration with other leaders in this sector such as ASML,[11] as well as invested in other chip designers, such as the British company ARM (which SoftBank also holds a significant stake in as part of their Vision Fund).[12]

3.2. Data centres

Data centres play a crucial role within this supply chain. As Neilson and Rossiter eloquently argue in *Data Farms*: 'Bringing critical attention to the coupling of algorithmic capitalism with data centres instantiates a materiality that helps demystify the abstraction often associated with processes of capital accumulation' (Hristova et al., 2022, p. 107). These facilities are considered digital warehouses processing data and algorithmic systems through the workhorse of chips and have become a significant capital attraction point for investors (Cancela, 2023). Driven by the modern capitalist reliance on digital technologies, the proliferation of data centres has surged across the globe. In fact, the AI industry is driving up the number of data centres given the amount of computational power is needed to satisfy its demand.[13]

However, data centres dedicated to train advanced AI products depend on GPUs, as the computing operations needed to train these algorithms cannot be executed without these chips. Given NVIDIA's GPU monopoly, big tech companies have decided to invest in their own semiconductors to reduce their reliance with a near-monopoly provider. For instance, Microsoft has recently announced its first own semiconductor, the 'Microsoft Azure Maia 100 AI Accelerator' to equip its data centres for ChatGPT. In turn, Microsoft is also designing their own data centre architecture and building racks from scratch which are customised with their own chip design. As stated by the executive vice president of Microsoft's Cloud + AI Group:

> 'Microsoft is building the infrastructure to support AI innovation, and we are reimagining every aspect of our data centres to meet the needs of our customers. At the scale we operate, it's important for us to optimise and integrate every layer of the infrastructure stack to maximise performance, diversify our supply chain and give customers infrastructure choice' (Jake, 2023).

However, the AI data centre industry is very heterogeneous, with participation not limited to big tech companies such as Amazon Web Services, Google Cloud, Meta Platforms or Microsoft Azure (Luitse, 2024; van der Vlist et al., 2024). Other data centre companies also play a significant role in this landscape, such as NTT Global Data Centres, Oracle, Equinix or CloudHQ. Interestingly, these companies partner with the big tech to host their services. For instance, Equinix partners with Microsoft to speed up Azure services.[14]

3.3. E-waste

Data centres are not an inert and permanent infrastructures. Their components and materials need to be replaced given a predetermined lifecycle.[15] This implies that the AI supply chain does not conclude in a data centre: rather, it moves to e-waste dumps or recycle plants. When a material or component reaches the end of its useful life in a data centre it is retired. For instance, scholars have found out the a lifecycle assessment of UK data centres and found that 100% of Ethernet cables, networking components, servers and IT storage could end up in e-waste treatment plans (Whitehead et al., 2015). Interestingly, this analysis shows that servers and storage are refreshed every three years. Components such as batteries or pipes have a refresh rate of 20 years, but part of their components end up incinerated or in landfills. Moreover, GPUs have a lifespan of 3 to 5 years. This last stage of the supply chain capitalism of AI illustrates the importance of connecting data centres with landfills and recycling plants, which are often overlooked as the end point of supply chains.

3.4. Labour figures

Labour figures within supply chain capitalism of AI should also be taken into account. In fact, several scholars have analysed how the digital workplace has transformed labour structures (Briken et al., 2017). Tsing argued that 'supply chains draw upon and vitalise class niches' (Tsing, 2009, p. 158), and in fact the supply chain capitalism of AI brings different labour figures. The supply chain capitalism of AI encompasses different supply chains with heterogeneous and diverse labour skills, with some labour figures exposed to serious exploitative conditions (Pun et al., 2016). In fact, it brings together a mine worker in Brazil extracting tungsten with a data centre engineer working in México with a data labeller in Kenya and a AI engineer working in the UK. This framework shows how the making of AI entails different skills such as extracting minerals in mines, manufacturing semiconductors in factories, programming algorithms or curating datasets. These supply chains make visible the proliferation of workers in different industrial sectors that might belong to different class and might be exposed to different mechanisms of exploitation and violence (Miceli & Posada, 2022; Muldoon et al., 2023; Posada, 2021; Precarity Lab, 2020; Wang & Jiang, 2021).

AI engineers working in big tech companies based in the UK might belong to upper class groups compared to those miners extracting tantalum from mines in Brazil or workers labelling datasets in Kenya – which strongly resonates with the diversity and hierarchy in labour of supply chains. Doing a basic search one can find out that while a miner in Brazil earns 5 EUR per hour, a data labellers earns less than 2 EUR per hour and an AI engineer at OpenAI makes 75 EUR per hour.[16] This blatant difference across hourly earnings within labour figures in AI exposes Tsing's argument on how supply chains vitalise class niches (Tsing, 2009). Overall, these labour figures illustrate that these supply chains operates through hierarchical tiers that are more visible and considered more relevant than others. For instance, AI engineers salary is higher than data labellers or even miners because their work is considered intellectually sophisticated. However, without the coordinated labour activity between the three of them (and

other workers) that is orchestrated throughout supply chains, we could have never developed a product such as ChatGPT.

4. Water struggles within the supply chain capitalism of AI: the data centre hub in Querétaro (México)

It is the end of October 2023 and I found myself in Querétaro, a region in the north centre of México.[17] I have been attracted to this territory by the large number of data centres that are being installed in its industrial parks. Querétaro has emerged as a data centre hub in the supply chain capitalism of AI. This state is already hosting 10 data centres with plans for an additional 18 projects to be installed within the next decade.

Querétaro has become attractive to the data centre industry due to several factors. The first factor is related with its industrial legacy. Querétaro is among the Mexican states experiencing rapid economic growth due to substantial in-flow of foreign capital. In interviews, many participants explained to me that the region became a hub for many US automative factories in the 2000s, which drastically transformed the economic and socio-demographic character of the region. After this boom, the aerospace industry expanded its cluster in Querétaro. Therefore, given that the region is already a cluster for various industries, the data centre industry finds it to be an ideal scenario for its deployment. The second factor is related with the geographical situation. Querétaro is two hours' drive from the capital, Ciudad de México. Moreover, there are sea cables landing in México which facilitates low latency for data centre connections. A third factor that emerged through my fieldwork was the willingness of the local government to facilitate the installation of data centres within the region. In fact, the local government of Querétaro yielded previously public land to an international data centre company to install its infrastructure in that territory, an scandal that was covered by the local press (Espinosa, 2023). At the time of writing this piece, the Governor of Querétaro is announcing on social media that Amazon will invest 5M USD dollars to deploy another data centre in this state – which is considered the largest capital investment in technology within México.

When I had the opportunity of visiting data centres operating in Querétaro, I learned that not all data centres are connected to AI technologies. For example, there are few data centres operating as data storage. Other firms are giving service to big tech companies that are connected to AI – such as Amazon or Zoom. But it is merely impossible to track all the firms within this supply chain of data centres. I also experienced that it is very hard to get access to these infrastructures and obtain information about their clients. Despite this opacity, the local newspapers announced that Microsoft will deploy three data centres that are estimated to use 49.50MW to satisfy the demand of ChatGPT – the most popular generative AI product– and other Microsoft services (see Figure 2). In fact, the supply chain capitalism of AI is going to be expanded in the near-term to satisfy the demand of generative AI, and Querétaro is becoming a key geographical point for this industry. As a consequence, the local government of Querétaro is already facilitating the infrastructure of its region by improving the electrical grid and water supplies (LX Legislatura de Querétaro, 2023).

One of the days close to *Día de Muertos*, the most popular Mexican celebration, I found a protest in front of the municipal council of Querétaro. I walked around and

PROYECTO CENACE	EMPRESA	UBICACIÓN	MW
1: VIBORILLAS	AWS	VYNMSA	28.00
2: YERBABUENA	AWS	AEROTECH	28.00
3: CANTERA	AWS	EXETER	28.00
4: CUES	EQUINIX	INNOVACIÓN	34.56
5: YACUMA	EQUINIX	VESTA	23.00
6: TRES POTRILLOS	ASCENTY	ARKANSAS	20.00
7: CHABACANO	ASCENTY	VESTA	16.50
8: LA ESPERANZA	MICROSOFT	ARKANSAS	49.50
9: SAN AGUSTIN	MICROSOFT	VESTA	49.50
10: LA LOMA	MICROSOFT	VYNMSA	49.50
11: PADILLA	YONDR	PIA	45.00
12: EL COLORIN	KYO	MARQUÉS	32.00
13: NAVAJAS	SCALA	ADVANCE	30.00
14: MIRADOR	SCALA	SJR	90.00
15: PEÑUELA	ORIGIN	ORIGIN	220.00
16: HIPICO	EL MARQUÉS	MARQUÉS	30.00
17: POZA SAN CARLOS	PTIQ	MARQUÉS	30.00
18: YAQUI	ENERPYME	PYME	60.00
19: ZOOLOGICO	ODATA	VYNMSA	36.36
TOTAL (MW)			899.92

Figure 2. Electricity demand of incoming data centres in Querétaro (México). AI data centres (Microsoft) and online gaming (Origin) are going to use the most electricity. Source: Found during fieldwork (LX Legislatura de Querétaro, 2023).

found several signs and posters where I could read 'It's not drought, it's looting', 'Water is not a business', or 'Water for the people, not for the companies' (see Figure 3). When I approached the tent where the people of the protest where having an assembly, I found out that the protest was orchestrated by the people of Maconí, a rural and Indigenous community based in the mountains of Querétaro. After 5 days walking from their community to the city of Querétaro, they came to protest in front of the local government to express *Su Derecho Al Agua* (Their Right to Water) (Mirosa & Harris, 2012). In 2006, the local government approached the community of Maconí with a proposal: they suggested extracting water from natural resources to provide it to its industrial parks in exchange

Figure 3. 'Water for the people, not for the private companies'. The community from Maconí protesting in front of the city hall of Querétaro in October 2023. Source: Own during fieldwork.

for improving the infrastructure of this community and providing access to drinking water. The community of Maconí agreed and signed an agreement. Afterward, the government of Querétaro built one of the largest hydraulic infrastructures within México: *Acueducto II* (AQII hereinafter).[18] Since then, this 123km-long pipe pumps water from the mountains in Maconí and brings it to the citizens within Querétaro and its industrial parks.

However, seventeen years later the local government not only failed to fulfil its promise, but the water resources of Maconí are drying up due to the amount of water that AQII extracts daily from springs. As published by official reports, this infrastructure is providing almost 50M m^3 of water annually to Querétaro, which means that is taken this large amount of water from the natural springs in Maconí (Conagua & Gobierno Federal de México, 2011). As a result, the Indigenous and rural community of Maconí is suffering from water scarcity. They have to walk even further to bring water to their houses to wash dishes, have a shower or water their subsistence farms.

The grassroot organisation *Bajo Tierra Museo del Agua* (Underneath Museum of Water) based in Querétaro has critically analysed the relationship between water resources and the large industrial parks surrounding the city. While Querétaro was the only Mexican State in 2022 with 100% of its territory in risk of drought, the industry water consumption grown from 4% in 2003 to 40% in 2018 (Bajo Tierra Museo del Agua, 2023). Moreover, this organisation also analysed that industrial parks have grown 17 times between 1970 and 2017 by 'advancing over areas of ecological value and aquifer recharge zones, degrading environmental systems and compromising water sustainability' (Bajo Tierra Museo del Agua, 2023, p. 19). Bajo Tierra Museo del Agua criticises the idea that industrial parks are bringing economic prosperity and modernity to Querétaro. As I observed during my fieldwork, the community of Maconí is demanding the local government to prioritise their need to access drinking water, rather than prioritise business activity.

5. Frictions within the supply chain capitalism of AI

My three months of fieldwork in México shows that the supply chain capitalism of AI exposes resource exploitation, environmental harms and resistance. The progress characterised by the industry of AI and its infrastructure is commodifying nature in a territory where communities are suffering water scarcity. This situation is leading to environmental injustice and power inequality.

This case also shows that we can investigate parts of supply chains and observe other types of harms and resistance that have not been analysed by critical AI studies before. The AI industry is deploying its infrastructure with frictions, catalysing controversies that arise due to environmental struggles. My fieldwork illustrates that the local government of Querétaro is promising that data centres are bringing innovation and employment to the region. But these promises obscure the commodification of nature leading by this industry. For instance, it was impossible to know how much water the data centres industry is using in Querétaro. While the data centre industry is making huge profit in Querétaro, the rural and Indigenous community of Maconí does not have access to water. This paper claims that algorithmic harms and resistance (Velkova & Kaun, 2021) need to be rethought by considering how the supply chain capitalism of AI is also impacting upon territory and local communities.

The objective of supply chain capitalism is to make profit with minimum costs by commodifying nature and digital services (Dyer-Witheford, 2015; Verdegem, 2024). Rather than engaging with techno-feudalism narratives, these supply chains expose that 'capitalism is moving in the same direction it always as been' (Morozov, 2022, p. 126). While the data centre industry and its profit might imply capital accumulation for some, it might cause natural resources extractivism and labour exploitation for others. While the local government is inviting the data centre industry to invest in this region promising technological progress, the people from Maconí are struggling to get access to water. This case shows that the situation in the community of Maconí is so dire that they have to walk 8 hours to irrigate their subsistence gardens with plants like nixtamal, which might not allow them to continue the tradition of cooking their indigenous cuisine. Therefore, algorithmic harms and resistance are also connected to frictions emerged within and around mines, semiconductor factories, data centres, technological firms, data labelling companies and e-waste dumps.

6. Conclusion

Several features proposed by Tsing (2009) resonates with the supply chain capitalism of AI nowadays. However, the main difference is that capitalist firms within the AI political economy are accumulating more capital in 2024 than Wal-Mart or Nike in 2009. Therefore, it is relevant to better understand the capitalist production line of AI. Supply chain capitalism offers a theoretical framework to take into account the production line of AI and its infrastructure, from mines to e-waste, and account for geographical asymmetries and environmental struggles that might no be evident. A closer examination into the supply chain capitalism of AI unveils environmental harms such as water struggles, which have not been considered by the algorithmic harms and resistance literature before.

This paper shows that contested struggles emerge by investigating specific points in the supply chains of AI. The case of Maconí shows that while the data centre industry is exploiting water resources to cool its digital infrastructure, people in rural and Indigenous areas do not have access to water. Juan, the middle-aged man quoted at the beginning of this paper, is nowadays living in Maconí and still walking at least eight hours to gather water for its daily live. This piece is a call to investigate the infrastructural impact of AI from critical and environmental lens and open a critique towards the growing AI industry so that we can build a world of many worlds where everybody fits (Blaser, 2018).

Notes

1. Nixtamal is original from Nahuatl, the lingua franca of the Aztecs (*nextli* – ashes of lime – and *tamalli* – cooked corn dough –), referring to corn grains cooked with water which is the foundation of traditional and indigenous cuisine in México.
2. Transcription obtained from a video published by the *Comunidad Agraria Maconí*'s profile on Tiktok on October 26, 2023. Available at: https://www. tiktok.com/@comunidad.agraria/video/7294349580286692613 (Last accessed November 13, 2023).
3. In this paper, I use indistinguishably the concepts of AI, algorithm or algorithmic system to refer to the systems proposed in the AI Act and its economic and industrial ecosystem (European Commission, 2021). However, I am aware that not all algorithms are AI.

4. This information was obtained during fieldwork visiting data centres.
5. See: www.tunubesecamirio.com (Last accessed December 5, 2023).
6. Native community from Oaxaca, Veracruz and Chiapas (México).
7. This semiconductor firm was found in 1993 using the acronym from its foundational documents labelled with the letters NV (next version), which in turn form the Latin word invidia (envy). See: http://fortune.com/2017/11/16/nvidia-ceo-jensen-huang/ (Last accessed January 24, 2024).
8. *Fabless* are companies that do not have factories for manufacturing their own electronics. Rather, they outsource the fabrication of semiconductors to other corporations with chip factories (fabs).
9. NVIDIA is a fabless firm that designs and supplies – rather than manufactures – semiconductors. It outsources the fabrication of semiconductors to other firms.
10. Note that while much has been said about lithium and AI (Crawford, 2021), this mineral is not a key element within the supply chain of AI and its infrastructure.
11. See: *NVIDIA, ASML, TSMC and Synopsys Set Foundation for Next-Generation Chip Manufacturing*https://nvidianews.nvidia.com/news/nvidia-asml-tsmc-and-synopsys-set-foundation-for-next-generation-chip-manufacturing (Last accessed February 27, 2024).
12. See: *NVIDIA Says It Will Invest In Arm's IPO After Failed Acquisition*https://www.crn.com/news/components-peripherals/nvidia-says-it-will-invest-in-arm-s-ipo-after-failed-acquisition (Last accessed February 27, 2024).
13. Concretely, Microsoft has declared its intention to construct more data centres to bolster ChatGPT (Rogers, 2023).
14. New Streamlined Azure ExpressRoute Experience with Equinix. See: https://www.equinix.co.uk/partners/microsoft-azure (Last accessed January 30, 2024).
15. In this paper, I consider the lifecycle from a product management perspective, which is 'widely understood as concept for the creation, storage, and retrieval of data, information and, ideally, knowledge throughout the lifecycle of a product from its conceptualisation or inception to its disposal or recovery' (Lämmer & Theiss, 2015).
16. Data extracted from Glassdoor, Time's report (Perrigo, 2023) and the Economic Research Institute on June 27, 2024.
17. During three months of fieldwork, I conducted 16 semi-structured interviews to private actors related with the supply chain of AI, environmental activists and citizens within México. I invited them to an interview through a snowball sampling that depart from identifying and contacting by email key actors before my fieldwork. Some participants were also invited to participate during my stay in Querétaro while walking through the city. I designed one unique interview model that focused on the infrastructural aspect of AI and its supply chain to analyse the environmental and political impact of this technology from their perspective.
18. See: https://www.gob.mx/conagua/articulos/acueducto-ii-de-queretaro-modernidad-hidraulica?idiom=es (Last accessed November 14, 2023).

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Notes on contributor(s)

Ana Valdivia is a Departmental Research Lecturer in Artificial Intelligence (AI), Government & Policy at the Oxford Internet Institute (OII) and Visiting Research Fellow at UCL Centre for Capitalism Studies. Ana investigates how datafication and algorithmic systems are transforming political, social and ecological worlds. Building on her experience as a mathematician and computer scientist, her interest lies in investigating how AI is impacting on local communities, borders and territories. In her current research, Ana aims to examine the political and environmental impact of AI by understanding its supply chains from mineral extractivism, data centres and electronic waste dumps. [e-mail: ana.valdivia@oii.ox.ac.uk].

ORCID

Ana Valdivia http://orcid.org/0000-0001-8214-8380

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