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— REPRODUCING OPERATIONAL LANDSCAPES: The Rock Mining for Indonesia's New Capital City

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Abstract

Indonesia's new capital city is designed to become a green and sustainable city. In this article, we examine the (un)sustainability of the process through which the city is coming into being. Using the sociospatial theory of planetary urbanization, we trace the dialectical relationship between the new city and sites beyond it to show how bringing a sustainable city into being in East Kalimantan requires other sites to become unsustainable. Through multi-sited fieldwork in Kalimantan and in extraction locations in the adjacent province of Sulawesi, we demonstrate how the making of a sustainable city relies on an unsustainable process of rock extraction elsewhere, reproducing the operational landscape from Kalimantan to Sulawesi. This highlights the importance of translocal geography perspectives for understanding official claims of sustainability in the new city vis-à-vis the grounded realities of planned urban development that generate unsustainability in other places. In terms of theory, we foreground the role of temporality in analyses of planetary urbanization, as reflected in the geological time formation of mined rock transferred to the new city and in the current and future environmental risks incurred in the reproduced operational landscape.

The promise of sustainability in Indonesia's new capital city development

Indonesia, a Southeast Asian country with a total population of 280 million, is in the process of relocating its capital city from Jakarta on the island of Java to Nusantara (*Ibu Kota Negara Nusantara*, hereafter IKN) on the island of Borneo, in the Penajam Paser Utara (PPU) district of East Kalimantan Province.

The IKN Master Plan (*Rencana Induk IKN*) embraces the idea of sustainable development, explicitly stating that the new capital will be built as a 'smart, green and sustainable' city (Presiden Republik Indonesia, 2022: 7). Even though the 'importance of taking account of the environmental costs generated or imposed by city-based activities on the people or ecological resources outside city boundaries' has been thoroughly discussed under the rubric of 'sustainable cities' (Satterthwaite, 1997: 1688), the idea of sustainability in the IKN Master Plan is directed more towards the city itself and how it will impact its immediate surroundings. In other words, the plan tends to follow the logic of 'methodological cityism' (Angelo and Wachsmuth, 2015), focusing on the planned city while neglecting its impacts on the landscape beyond it.

We draw on theoretical discussions on unsustainable development in translocal geographies and the operational landscape of planetary urbanization to explore the

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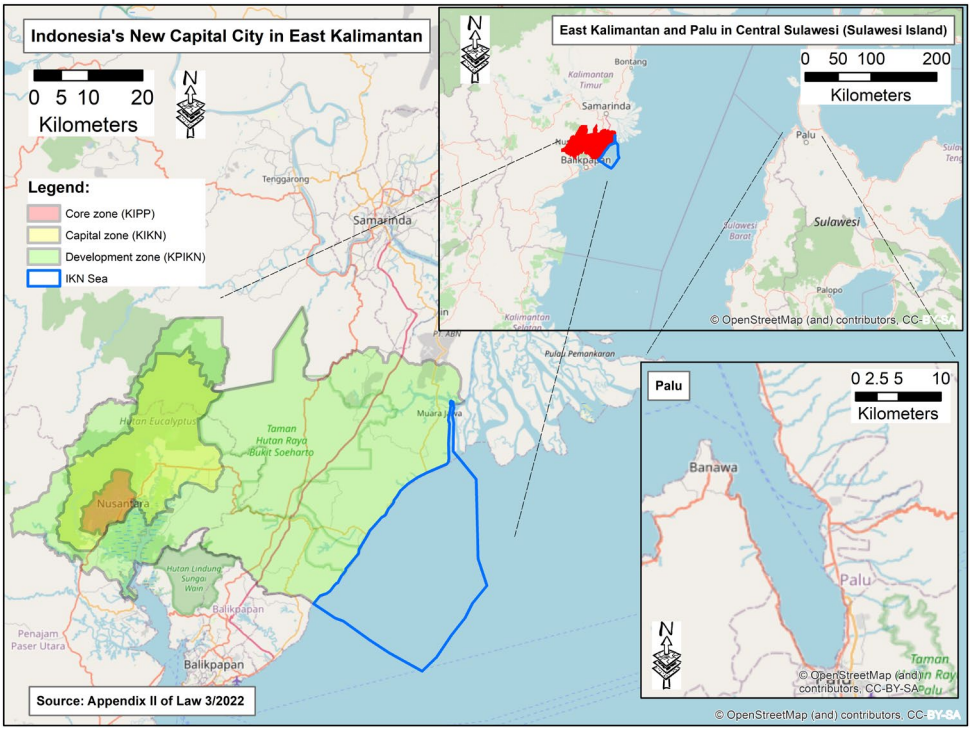

FIGURE 1 Nusantara in East Kalimantan and its operational landscape, Palu in Central Sulawesi (source: OpenStreetMap from ArcMap, 2023)

impacts of this sustainable city-making beyond the planned boundary of the new capital city. Inspired by 'follow the flow' methodology in urban political ecology (Kaika, 2005: 7), we follow the flow of stone for the development of the new city from East Kalimantan to its source on Sulawesi Island (Figure 1). By the time Nusantara was officially inaugurated in August 2024, a succession of concrete factories had been built in the vicinity of the main road in Sepaku, a sub-district of PPU where the new capital city is located. Construction materials, such as sand, stone, and cement, also piled up in front of villagers' houses, indicating that many Sepaku residents were building new houses or adding rooms for rent.[1] However, Kalimantan does not produce sufficient construction materials, either quantitatively or qualitatively, to meet demand.[2] The materials had to be sourced elsewhere: landscapes beyond the city were operationalized to provide materials for the new capital city.

Across the Makassar Strait from Kalimantan, the island of Sulawesi is one of Indonesia's national major production areas for construction materials and minerals such as nickel (Batubara *et al.*, forthcoming), providing vital materials for the new capital. By following the flows of stone from Sulawesi to Kalimantan, we show how the impacts of the new capital city project are neither spatially bounded by its location nor temporally bounded by its period of development, but extend into other places and across time. In terms of theory, we draw on the uneven development of translocal geographies (Zoomers and van Westen, 2011) and the operational landscape of planetary

1 This claim is based on conversations with villagers and observations during a visit to Sepaku, 12–19 August 2024 (Note 75).

2 Kalimantan is the Indonesian portion of the island of Borneo, which is shared by Indonesia, Malaysia and Brunei.

urbanization (Brenner and Katsikis, 2020). Constituted by materials such as stone and sand (Choplin, 2023), the operational landscape 'extends' urban frontiers far beyond where 'concentrated' urbanization is planned and implemented (Schmid, 2023). We use rock as a temporal agent to bring time into the socio-spatial theory of planetary urbanization. This framework allows us to adopt a concrete translocal perspective to analyse how building a sustainable city at one pole can produce spatio-temporal unsustainability at the other. In contributing to the framework of planetary urbanization, we explain how the PPU, as the centre of planned urbanization in IKN, was once the operational landscape of planetary urbanization and how this landscape is now being reproduced in Sulawesi.

In the next section below, we discuss the theoretical contributions of this study, drawing on both the uneven development of translocal geographies and the operational landscape of planetary urbanization. The section after that explains our methodology of following stones. We then present the study area, Penajam Paser Utara (PPU), and how it has been operationalized over time. A further section presents the ongoing urbanization processes: the development of the new sustainable capital city in East Kalimantan, the sourcing of stone in Central Sulawesi, the experience of Watusampu Village at the site of rock extraction, and the uneven and unsustainable development. The final section highlights our contribution and the practical implications of our analysis for the development of IKN, including how it should go beyond methodological cityism.

Reproducing an operational landscape

The ideal of sustainable urbanization is one of the key agendas that emerged from Habitat III, the United Nations Conference on Housing and Sustainable Urban Development held in 2016. Sustainable urbanization is defined as a harmonious process in which everyone has the right to participate in making decisions about the direction of urbanization and to access affordable housing (Zoomers *et al*., 2017). However, urbanization often works unevenly, as it shapes 'development corridors' that facilitate flows of capital, goods and people for the 'development' of one place while exploiting other places or actors elsewhere (Zoomers and van Westen, 2011). Such translocal effects of urbanization are currently being observed in the promotion of sustainable urban development in Nusantara, located in East Kalimantan. This location's social and economic history shows that, functioning as a site of resource extraction, it served as an operational landscape for Indonesia's national development centred in Java. The latest city development reproduces this operational landscape in other places.

The notion of an operational landscape foregrounds the role of non-cities in urbanization. It is a critique of urban studies, which privileges the city as a bounded space of settlement in its analyses. The act of privileging the city or *cityness* is embedded in 'urban age theory', which defines the bounded city in terms of population (Brenner and Schmid, 2014). Instead of scrutinizing the city as a bounded space, planetary urbanization, described as 'a new epistemology of the urban' (Brenner and Schmid, 2015), proposes a different approach. This new epistemology of the urban positions the city as a sociospatial concentration of people and labour, things (means of production) and money-capital, while the operationalized landscapes of the hinterland are extensions that support this concentration. The sociospatial concentration in the city is termed concentrated urbanization; the support provided by the hinterland constitutes extended urbanization. The spaces of concentration and extension are dynamically interconnected both through and within the cycle of differential urbanization—making, destroying and remaking sociospatial arrangements. The notion of operational landscape then foregrounds the hinterland question in the era of Capitalocene (Brenner, 2016; Brenner and Katsikis, 2020; Brenner and Ghosh, 2022).

Critiques of planetary urbanization theory have also emerged, mainly from feminist, decolonial, post-human, and Southeast Asian perspectives. Critics point to a

general lack of 'engagement with the long legacy within feminist urban scholarship' to problematize the conception of the city (Buckley and Strauss, 2016: 617), identifying planetary urbanization as another male-dominated and Eurocentric totalizing analytical framework (Derickson, 2018: 559). Decolonial perspectives call for engagement with Southern views and experiences (Schindler, 2017; Khatam and Haas, 2018), indigenous claims (Kipfer, 2018), and post-coloniality (Reddy, 2018; Vegliò, 2021) to be integrated into the planetary urbanization framework. Post-human perspectives emphasize that cities also need to be conceptualized as having an agrarian element, such as nonhuman cattle (Barua, 2023: 191–4), a condition that is also applied to the non-city (Bathla, 2024). Perspectives from Southeast Asia include not only urbanization but also geographies of ruralization (Gillen *et al*., 2022).

We engage these critiques to foreground the peripheries—social and ecological reproductions, private, female, the outside, the residue, the ruins, the suburb, the rural/agrarian, the non-human—in their dialectical relationships with the core: capital reproduction, public, male, the inside, the essential, the commercialized, the city centre, the urban, and the human (see Buckley and Strauss, 2016; Derickson, 2018; O'Callaghan, 2018; Oswin, 2018; Peake *et al*., 2018; Pratt, 2018; Ruddick *et al*., 2018; Ghosh and Meer, 2021; Batubara and Rachman, 2022). By foregrounding the peripheries in planetary urbanization theory, we aim to avoid totalizing narratives (McLean, 2018) without losing a 'totalizing thought' on capitalist urbanization (Goonewardena, 2018: 462). By foregrounding peripheries to understand the impacts of the planned urbanization promoted through the new, sustainable city development, we aim to explain the operational landscape as a 'constitutive outside' (Roy, 2015: 813; Conroy, 2024) of urbanization. In so doing, we investigate how rock mining activities for the construction of the new capital city in East Kalimantan lead to the reproduction of another operational landscape in Central Sulawesi, mobilizing not only 'life', such as human labour, but also 'nonlife', such as rock, over time (Povinelli, 2016).

Rock enables us to be explicit about the temporalities of planetary urbanization and the production/reproduction of the operational landscape. Rock has its own geological time formation, and as it produces pollution during the mining process, it encroaches on the current and future lives of residents whose villages were transformed into rock mining sites. The longer residents stay close to the rock mines, the more they must endure these environmental impacts. Residents are therefore not 'borrowing' (Lei, 2021: 7) but pawning their future by 'inhabiting the extension' (Simone *et al*., 2023), living a risky and unhealthy everyday life in the operational landscape. We pay attention to the geological time formation of the mined rock and to the current and future environmental risks as 'hidden abodes' (Fraser, 2014) of rock mining. Within these hidden abodes, the turnover time of capital structures the circulation of mined rock. Throughout this temporal flow of rock from the past to the future, Sulawesi's rock mines become, and are likely to remain, an operational landscape that is continually extended and reproduced to support the sustainable urbanization of Indonesia's new capital city in East Kalimantan.

In other words, the development of the sustainable new capital city has opened an avenue for the reproduction of the operational landscape in Central Sulawesi, through which rocks were mined and mobilized as a commodity to build the new capital city. This process not only shows the uneven translocal development of the 'centre', but also the changing nature of the rock itself, rock mines, and people at the sites of extraction, because what constitutes the 'peripheries' is impacted as the city develops over time. Conceptually, the reproduction of the operational landscape therefore co-evolves with the geological reproduction of the mined rock, the social reproduction of the exploited labour, and the capital reproduction of investment.

Methodology: researching the reproduction of operational landscape

Our fieldwork for this article is anchored in the concept of the 'site multiple' (Connolly, 2019: 64; Robinson, 2022: 150; see also Saguin, 2022: 3; Choplin, 2023: 21), both at the landscape of PPU, once operationalized in East Kalimantan, and in the landscape of its extension and reproduction in the rock mines of Central Sulawesi. We used three methods: document analysis, interviews and field observation.

In our document analysis, we analysed online news and reports on IKN, as well as policy documents such as the IKN Master Plan, to understand the plan and progress of the new capital. We visited the Manggala Wanabakti Documentation and Information Centre at the Office of the Ministry of Environment and Forestry in Jakarta to access archives documenting the history of logging extraction and industrial plantations in PPU to contextualize our analysis.

We complemented these data with primary research using interviews and field observation. Fieldwork was conducted in three periods. The first visit to East Kalimantan and Sepaku was undertaken by the lead author in August–September 2022. The second occurred between December 2022 and May 2023. During the second period, March–April 2023, the lead author spent a month in Palu, the capital of Central Sulawesi Province, where the rock mines are located. The third visit to Sepaku and East Kalimantan was undertaken 12–19 August, 2024 by the first and second authors.

In Jakarta and in Samarinda, the capital city of East Kalimantan Province, we interviewed NGO activists and government officers (four recorded interviews). In Sepaku, we recorded 28 interviews. We interviewed the *Lurah* (head of a *kelurahan*, or urban village, appointed by the district head) and the *Kepala Desa* (head of a *desa*, or village, elected by the villagers). We also interviewed labourers, including dam and concrete-factory engineers, workers, heavy equipment operators, and drivers. In addition, we interviewed residents of the Indigenous Balik community in Sepaku, the group with the strongest claim to indigeneity in Sepaku at present, as well as residents who had themselves or whose families had moved from Java as part of the transmigration programme in the 1970–80s. In Central Sulawesi, we interviewed NGO activists; government officers from the Mineral Resources Agency of Central Sulawesi Province and from the tax/revenue office of Palu; the director of a provincially owned mining company; Palu's harbormaster; Lurahs; the owners and project manager of a rock mining company; mine workers; and residents who shared their experiences and knowledge (17 recorded interviews).

We organized the fieldwork data into two categories. The first consists of fieldnotes, produced through daily interactions, arranged conversations and observations. As of September 2024, this dataset included 75 notes (Notes 1–75, totalling 202 pages). The second category consists of recorded interviews, with lengths varying from 20 minutes to more than one hour. In total, we collected 49 recorded interviews (Interviews 1–49), 20 of which have been transcribed (totalling 1,234 minutes). During the research process, we iteratively revisited and analysed all the datasets, comprising documents, notes and transcribed and non-transcribed interviews.

Study area: Penajam Paser Utara as an operational landscape

The PPU has historically been an operational landscape of planetary urbanization. Logging extraction in the 1960s targeted primary forest for Indonesia's domestic consumption and for export to centres of planetary capitalism—including Japan, China, the United States, Canada and many countries in Europe and the Middle East (Barr, 1998; Gellert, 2003). According to one of our interlocutors, Satu (pseudonym), who was born in 1965 and is part of the Indigenous Balik community, a company came in and extensively cut down trees when he was a child. 'It was a Workoser company', Satu explained, 'an American-based company, perhaps the name of the owner is Delong' (interview 11 August 2022).

In 1969, PT International Timber Corporation Indonesia Kartika Utama (PT ITCIKU), a holder of a logging concession (*HPH*, *hak penguasaan hutan*, the right to cut forest), was established through cooperation between Karya TNI-AD Republik Indonesia (IRDA), the business wing of the Indonesian Army, and the Delong Corporation (a USA-based logging company)—'Delong' in Satu's explanation above. Later, the Delong Corporation became Weyerhaeuser Far East Ltd., referred to as 'Workoser' in Satu's pronunciation (PT ITCIKU, 2005a: II-1920). This USA-based logging company formed part of the broader foreign capital inflows to Indonesia following the ideological shift from the nationalist-left government under Sukarno to the pro-global capitalist government under Army General Suharto in 1965–67 (see Larasati, 2013). In 1970, the total logging concession area of PT ITCIKU was 601,750 hectares (PT ITCIKU, 2005b: II-1). The forest, on which the Indigenous community depended for countless daily needs, was felled by this company for logging extraction (interview with Satu, 11 August 2022). Currently, Hashim Dojojohadikusumo, the younger brother of Prabowo Subianto, who won the 2024 Indonesian presidential election, is the main commissioner of PT ITCIKU (Johansyah *et al*., 2019: 3).

The Indigenous population was too small to meet the company's labour needs for logging extraction. They were 'not a fully proletarianized work force', as they still had their land and were thus 'more difficult to maintain and control' (Gellert, 1998: 277). One solution for the logging companies was to mobilize labour through the transmigration programme from the densely populated island of Java to East Kalimantan.

The national government's transmigration programme is widely considered to have expanded the frontier of capitalism from Java to the outer islands (see Mukrimin and Acciaioli, 2023). In East Kalimantan, transmigrants were crucial in supplying labour to logging extraction and subsequent industrial plantations (Ibra, 1981; ATK, 1991; Gellert, 1998: 311; see also Akhter and Al Faruq, 2025: 1291). In Sepaku, transmigrants officially began settling in Bukit Raya Village on 26 August 1975. By the end of the last government-initiated transmigration programme in the 1980s, a total of 4,000 families had settled in eight villages in what is now known as the subdistrict (*Kecamatan*) of Sepaku in PPU.[3] They were moved from East, Central, and West Java, as well as from Jakarta, the old capital city (Ibra, 1978).

The experience of our interlocutor, Dua (pseudonym), illustrates this. In 1977, when Dua was a child, he moved with his family from East Java as part of the transmigration programme. In East Java, his father was a *buruh-tani* (peasant labourer) seeking a better opportunity for his family. In East Kalimantan, Dua spent his time in and out of labouring jobs from one logging or plantation company to another (Interview, 24 December 2022). Through people like Dua, the labour power from Java operationalized the PPU's landscape. With a pool of accessible labour power supplied by the transmigration programme, PT ITCIKU expanded logging extraction in 1993 by establishing the industrial plantation company PT ITCI Hutani Manunggal (PT IHM).[4] Instead of only extracting the primary forest, the company built an industrial plantation to cultivate trees such as acacia and eucalyptus (PT IHM, 2014: ii), a move from a

3 Many interviewees (interlocutors) said that they or their families moved from East Java Province under the transmigration programme, including those interviewed in August and December 2022. In February 2026, Bukit Raya Village's website was no longer online. A different source explained that, by the 1990s, almost 20,000 transmigrants had been mobilized to Sepaku (Database of Transmigration Locations [Pusat Data dan Informasi Transmigrasi/Pusdatintrans], 2005, quoted in Final Report on the Preparation of the Master Plan and Development Strategy of the National Capital, 2020, cited in Swara *et al*., 2026: 145).

4 PT IHM has a total concession area of 161,127 hectares. Until 2004, PT ITCIKU held 30% of PT IHM's shares, while PT Inhutani-I, a parastatal plantation company, held 40%, and PT Kreasi Lestari Pratama held the remaining 30% (PT IHM, 2014: iii and 1). As of 2019, the majority of PT IHM shares are owned by Indonesian businessman Sukanto Tanoto (Johansyah *et al*., 2019: 2), the main figure behind PT Kreasi Lestari Pratama (Koalisi Anti Mafia Hutan, 2020: 16–17). In August 2023, Indonesia's Investment Minister, Bahlul Lahadalia, stated that Tanoto would invest in the IKN Project (Hidayatullah, 2023), which has its centre within the PT IHM concession.

'formal' to 'real subsumption' of the operational landscape under capitalism (Brenner and Katsikis, 2020: 28; see also Batubara, 2025).

The next phase of landscape operationalization occurred through the introduction of oil palm plantations, implemented by smallholders and large-scale investors. Smallholder schemes are run by residents, while the large-scale palm oil plantation of PT Agro Indomas East Kalimantan (AIEK), which is mainly controlled by a Singapore-based corporation, began operating in Sepaku in 2004. PT AIEK initially encroached on a total area of 17,500 hectares and expanded by another 11,918 hectares in 2011. Many villages in Sepaku subdistrict are now surrounded by oil palm plantations. For example, Pemaluan Village is one of the closest villages to the centre of the new capital city, *Kawasan Inti Pusat Pemerintahan* (KIPP; see Figure 1). Sixty percent of its total area is under the control of PT AIEK (Kusumawardhani, 2022: 21).

The PPU District is also home to a large number of coal mines. According to Johansyah *et al.* (2019: 5), at the time PPU was selected as the site for the new capital city, there were 66 documented coal mining concessions in the district. Myrna Safitri, Deputy for Environment and Natural Resources at the IKN Authority (*Badan Otorita IKN*), who oversees the new capital city, explained that there were 61 coal mining permits/concessions within the IKN area (Kencana, 2023).

The new capital city is the latest outcome and means of landscape operationalization in Sepaku. The IKN Master Plan divides the new city into four zones (see Figure 1). The first is the inner core zone for government offices, *Kawasan Inti Pusat Pemerintahan* (KIPP), which has a total area of 6,671 hectares. The second is the city zone, *Kawasan IKN* (KIKN), which has a total area of 56,180 hectares, and the third is a zone for further development, *Kawasan Pengembangan IKN* (KPIKN), which has a total area of 199,962 hectares. In total, 256,142 hectares of land are designated for the new capital city. In addition to the land area, a total of 68,189 hectares of sea territory is included under the jurisdiction of IKN (Presiden Republik Indonesia, 2022: 8–9). As of April 2023, all ongoing developments in the new capital city are concentrated in and around the KIPP and funded primarily through the state budget[5] as part of government efforts to attract non-state investment for the urbanization of East Kalimantan.

Results: sustainable city making in IKN and unsustainable extractivism in Sulawesi

– Urbanizing East Kalimantan through IKN

The IKN Master Plan justified the establishment of a new capital city by presenting it as a sustainable city, to be materialized through the concepts of the forest city, smart city and sponge city. The forest city refers to the reforestation of degraded forest and the designation of a substantial share of the new capital city as green space. The smart city aims to incorporate state-of-the-art information, communication and transportation technologies into the new city. The sponge city imagines the new city as water-sensitive, addressing both flooding and drought (Presiden Republik Indonesia, 2022: 25–31).

The overall design of the new capital city reflects the point precisely identified by Tzaninis *et al.* (2020: 237): 'Whilst academic debate moves beyond privileging cities as objects of inquiry, cities are increasingly becoming the preferential sites of policy and governance experiments'. The IKN Master Plan (Presiden Republik Indonesia, 2022) has a strong city-centric focus, reinforcing methodological cityism. In Al Faruq's words (2025: 1771), IKN is an 'exemplary centre'.

5 CNNIndonesia.com, 'Basuki ungkap alasan realisasi investasi swasta di IKN Masih Nihil [Basuki reveals reasons for still zero private investment in the New Capital City]'. *CNNIndonesia*, 28 April 2023. URL https://www.cnnindonesia.com/ekonomi/20230428150439-92-943120/basuki-ungkap-alasan-realisasi-investasi-swasta-di-ikn-masih-nihil (accessed 1 May 2023).

This city-centric orientation is reflected in the key performance indicators (KPIs) of the IKN sustainable city (Presiden Republik Indonesia, 2022: 17). Among these indicators are the allocation of land for green space, the integration of incoming migrants with the existing population, accessibility to and within the city, safety, the development of information technology, and targeted economic development. For instance, in terms of land use, 65% of the total area of the new capital city is designated as green space. Likewise, in economic terms, zero poverty among the new capital city population is set as a target for 2035 (*ibid*.).

All indicators tend to focus on what is designed in and for the city. The areas beyond the city that are being operationalized to enable the functioning of the new sustainable city remain absent from the indicators, or perhaps constitute a form of 'erasure' (Reddy, 2018). The Master Plan does include measures related to areas beyond the city, such as indicators for carbon emissions, waste management, and the water cycle.[6] What it does not do is explicitly attempt to reduce, influence or engage with the impacts of the city's construction activities on distant environments. The IKN Master Plan, therefore, is evidence of how the city will be fabricated through 'imagineering' (Ranganathan, 2015: 1301), based on the imagination of engineers and planners who assume that the city is a bounded space.

During our fieldwork, we observed that the road in Sepaku was crowded with newcomers—people working for the IKN Project or conducting research, as we have done since 2022. In 2023, one of the concrete companies supplying IKN was located in *Kampung Tengah* (Village in the Middle), between the villages of Bumi Harapan and Bukit Raya, about five kilometres from the centre of *KIPP* (the so-called *Titik Nol*). From the main road, it was difficult to see what was happening inside the factory grounds, as a fence blocked the view. What passers-by could see beyond the white iron sheeting fence was heavy equipment, freshly bulldozed reddish soil, and the top of a stone mound.

According to Tiga (pseudonym, a plant coordinator interviewed 28 February 2023), the company was building a precast concrete factory on a 9-hectare site. The factory is owned by Brantas Abipraya, a state-owned infrastructure company. The palm oil plantation was bulldozed to make way for the precast concrete factory under construction. In 2023, workers were active at the project site. Some operated heavy equipment, such as backhoes, to level the ground, while others installed the components of the factory. They were building the access road, laying the foundation of the batching plant, preparing a stockyard for storing stone, and developing the production area, where a large, tube-shaped stone-mixing tower had been installed. The factory would supply U-ditch drains for roadside gutters, box culverts, corrugated concrete sheet pile (CCSP), and other precast concrete products for the IKN Project.

Developing a new sustainable city exploits labourers who live precarious lives, often working far from their families without clear employment contracts. They were often deceived by (sub)contractors; some even succumbed to malaria.[7] In the early stages of factory development, approximately 25 labourers were working on the site. Labourers with the skills required for the concrete factory, such as Tiga, were mobilized by Brantas Abipraya from East and Central Java. Labourers without specific skills were those who had previously worked for the timber plantation. Two labourers from North Sumatra illustrate this pattern. A subcontractor of PT IHM promised to pay them IDR 3 million per month for maintaining the grass in the plantation area. After they arrived in Sepaku, they were only paid IDR 500,000 per month and tasked with cutting trees. They then left the subcontractor and eventually secured jobs with PT Brantas Abipraya. Brantas Abipraya hired local drivers and their trucks, including Empat (pseudonym, interviewed

6 The development of water infrastructure violently affects Indigenous communities (Swara *et al*., 2025).

7 PPU is acknowledged as an endemic site of malaria in the Master Plan of IKN (Presiden Republik Indonesia, 2022: 40) and was also recorded in media reports during the transmigration era in the 1970s (Ibra, 1978).

4 March 2023), to transport stone from the harbour at the Sepaku riverbank in Bumi Harapan Village to the factory site.

– Where the construction materials come from

The stone was transported from Palu, Central Sulawesi. According to Lima (pseudonym, an engineer at the precast factory site, interviewed 28 February 2023), the company sourced stone from far away in Sulawesi, rather than from within Kalimantan. In Lima's explanation, Kalimantan's rocks typically have an abrasion rate up to 24%, whereas rocks from Palu have a lower abrasion rate of 14%. The lower the abrasion rate, the higher the resistance of the rock, which makes it more suitable as a construction material.[8] Even when crushed into pieces smaller than 5 cm, the rock retains its basic properties, including its pore and cleavage structures, and the resistance of the rock is reflected in the shape of the crushed material. Cubical-shaped crushed rock is more resistant than flat-shaped crushed rock, which is why rock from Palu is preferred for building infrastructure such as roads and dams.[9] Another interlocutor (a Sepaku-Semoi Dam engineer interviewed 11 May 2023) noted that sourcing stone from Palu is cheaper than from other locations, including areas within Kalimantan. Rocks from Palu can be transported from the Makassar Strait to Bumi Harapan via the Sepaku River (Figure 1).

When the lead author arrived in Palu in March 2023, the first information received came from an online taxi driver, who spoke about the 2018 earthquake, liquefaction and tsunami. In 2018, Palu was struck by a magnitude 7.4 earthquake, which caused liquefaction in the city. Waves from the tsunami in Palu Bay reached a height of 0.53 meters approximately 20–25 minutes after the quake. The epicentre was located 10 kilometres below the surface along the Palu-Koro Fault, described as 'a 220-km-long' major fault 'with prominent expression' (Patria and Putra, 2020: 1). It is one of the most active geological faults in eastern Indonesia. Since the 1990s, *Kompas*, a major Indonesian media outlet, has documented six significant earthquakes of magnitude 5.5 or higher along the Palu-Koro Fault (Arif, 2018).

Poverty data reflect Central Sulawesi Province's position within Indonesia's outer islands and its location in the national periphery. In the first half of 2023, 12.41% of Central Sulawesi's population was categorized as poor (*miskin*) according to state statistics. This percentage exceeds that of all provinces on the island of Java, the inner island of Indonesia, while the highest poverty rate for the same period was recorded in Central Java Province (10.77%) (BPS, 2023).

Apart from its vulnerability to disasters (earthquakes, liquefaction, tsunamis) and its higher poverty rate, the province's capital, Palu, is well known in Indonesia as a source of stone for construction. Pebbles for the MotoGP Mandalika Circuit on the island of Lombok were sourced from Palu (Priatmojo, 2022). According to a scholar-activist in Palu (interviewed 23 March 2023), many owners of rock mines in and around Palu are entrepreneurs based in Central Sulawesi or elsewhere in Sulawesi. Following the launch of the IKN Project, many entrepreneurs from Jakarta—including powerful politicians from the central government—most likely also participated in the rock mining boom in Palu.

Rock mine concessions are located along the top and cliffs of the Palu-Koro Fault Zone (Figure 2), between the city of Palu and Donggala, an older city in Central Sulawesi. On the right side of the Palu-Donggala Road, there is a sweeping view of Palu Bay, contrasted with rock mines on the left. In total, there are 53 rock (non-metal) mines in Palu and Donggala (Koalisi YLBH Apik-Komiu, 2017). Among the 26 rock mine concession records available to us, one pattern is clear: the total area of a rock mine

8 Information provided by an engineer at a concrete factory in Sepaku, interviewed 4 March 2023.
9 According to a head mining engineer (*kepala teknik tambang*) in Palu, who confirmed that rock from Palu has an abrasion rate of 14–18%, when interviewed on 5 April 2023.

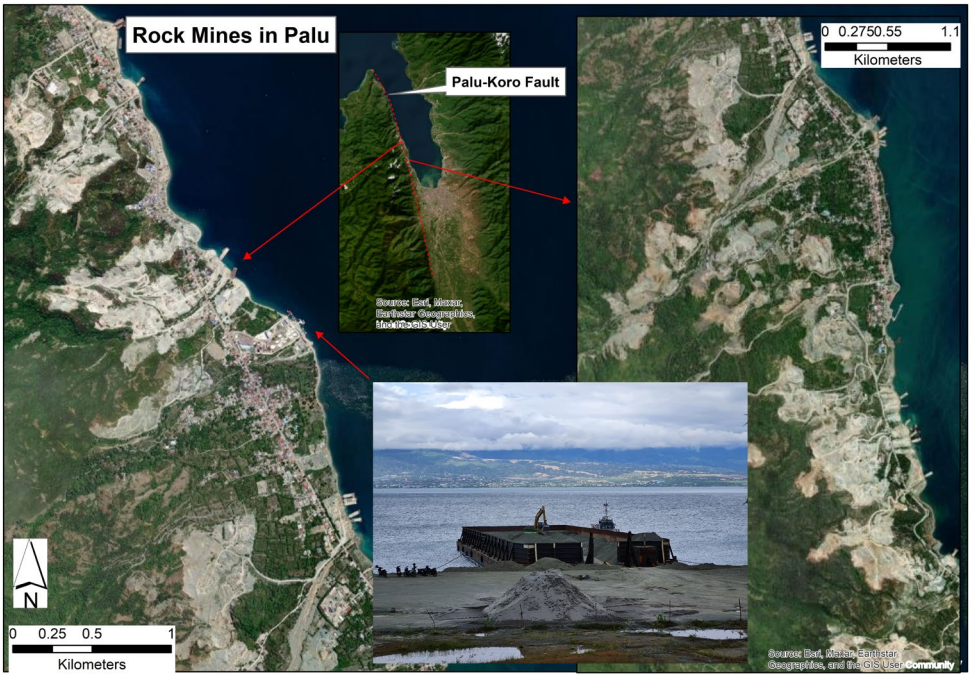

FIGURE 2 Rock mines along the Palu-Koro Fault in Central Sulawesi and loading activities at Watusampu Village, Palu Bay (*sources*: map from Esri, Maxar, Earthstar Geographics and the GIS User Community, 2023; photo by Bosman Batubara, March 2023)

concession in Palu is far smaller than that of concessions for other minerals, such as gold. Rock mine concessions range from 9.63 hectares to 98.28 hectares; all are under 100 hectares. In contrast, gold mining concessions can exceed 21,000 hectares.[10]

The significant difference in total area affects the type of land acquisition. Because of the large area required, land for gold mining is usually claimed and allocated by the state to gold mining companies. This is likely because the majority of land in Indonesia is owned by the state (Lund, 2023). For the much smaller areas required for rock mining in Central Sulawesi, companies must purchase and aggregate small plots of land from owners or residents. Hence, for rock mines in Palu and Donggala, state-issued concessions grant the right to mine rock, but, as far as land ownership is concerned, whereas the state retains the majority of land parcels for gold mining, land for rock mines is purchased and owned by private mining operators (Koalisi YLBH Apik-Komiu, 2017: 8). As villagers' land ownership was curtailed, as shown by the case of Watusampu village below, many of them were transformed into labourers for mining companies.

– The experience of rock mining in Watusampu village

In Watusampu Village, located between Palu and Donggala, rock mining began in the 1990s. All rock mine concessions are located on cliffs along the Palu-Koro Fault. Before mining began, land on the cliffs was typically planted with cassava, corn and bananas. If a miner targets a specific area, the first step is to contact the *Kelurahan*

10 Mine concession data were tabulated by a Palu-based NGO, Yayasan Komiu.

office to identify the landowners. The *Kelurahan* office then invites the landowners to meet with the miners. For villagers, the difficulty of earning cash income and the fact that the land is rocky and barren (*berbatu dan tandus*) make selling a more attractive option. If they agree, the miners purchase the land (interviews with the heads of Watusampu village and Buluri village, a neighbouring village to Watusampu, both dated 3 April 2023).

In the 1990s, the price of land for one square meter on the cliffs was IDR 10,000. In the early 2000s, it rose to IDR 25,000, and by 2023, following the introduction of the IKN Project and its demand for stone, it reached IDR 50,000. Land claims frequently overlap. In one instance, a resident claimed a plot of land legitimized by a *Surat Kepemilikan Penguasaan Tanah* (SKPT), a letter confirming land ownership and claim issued by the *Kelurahan* office. Years later, when the *Lurah* changed, another resident from the same family claimed the same plot of land, legitimized by an SKPT issued by the new *Lurah*.[11]

In addition to acquiring land on the cliffs for mining, a rock mining company must also secure land for a dock or jetty in the coastal area of Palu Bay. On the coast, land prices are higher than on the cliffs. Prices can range from IDR 200,000 to 500,000 per square meter. Land prices at the beach increase significantly when a mining company expresses interest in building a jetty. A jetty requires approximately 100 square meters of land. The primary consideration is securing a plot with at least 20 meters along the coastline to enable ships to dock. After purchasing such a plot, the mining company extends the land up to 20–30 meters into the bay through land reclamation (*timbun laut*, filling up the sea).[12]

To mine rock, the mining company must first obtain a permit from the provincial government. According to an interlocutor, a project manager (*kepala teknik tambang*, mining head engineer) at a rock mine site in Watusampu (interviewed 5 April 2023), the permit is valid for five years. After the permit is obtained, the mining company must conduct a geoelectric survey to determine the total reserves in the concession, including underground reserves. If the geoelectric equipment is sufficiently sensitive, it can detect a boulder at depths of up to 120 meters. The geoelectric survey detects only the size of the rock, such as boulders or *batu gajah* (elephant rock), not their type or composition.

The rock mining company must remove the topsoil, referred to in technical language as 'overburden'. The thickness of the topsoil varies but can reach as much as 10 meters in depth. In some cases, miners find boulders within the topsoil that are strong enough to be processed and crushed into construction material. At a rock mine in Watusampu, the highest elevation above sea level at Palu Bay is 110 metres, and the lowest is 40 metres. The mining company, therefore, has a vertical depth of 70 metres available to it within a total concession area of 10.6 hectares. Using 3D geological software, the project manager estimates that the company has a total volumetric reserve of 1.5 million cubic meters of rock at this location. Based on this estimate, the project manager (interviewed 5 April 2023) plans an annual production of 240,000 cubic meters and expects the entire reserve to be extracted over approximately 6.25 years.

Moving upslope from the mining concession, the mountain at the top of the cliff forms what geologists call the 'Tinombo Formation'. This formation extends north–south along the Palu-Koro Fault and consists of metamorphosed sedimentary and volcanic rocks, with a total thickness that can exceed 8,000 metres (van Leeuwen and Muhardjo, 2005: 483, 491–92). The Tinombo Formation has been deformed by the

11 Overlapping land claims are part of the strategy government officials use to extract money, as each step in the land claim legalization process presents an opportunity to generate income (discussion with a legal expert in Semarang, the capital of Central Java Province, September 2023). See also Bachriadi and Aspinall (2023) on land mafias and corruption in Indonesia, and Habibi (2023: 195) on corruption in land legalization.

12 The data and narrative for Watusampu village in this section are drawn from previously mentioned interviews held with the heads of Watusampu and Buluri villages on 3 April 2023.

Palu-Koro Fault, which uplifted the upper block to form the mountain and displaced the lower block downward. The mountain later became the source of eroded material, while the lower block became the depositional area for these sediments. In geology, such a morphological setting is called an alluvial fan.

As an alluvial fan deposited more than 120,000 years ago (Bellier *et al*., 1999), the rock formations in Watusampu consist of a mixture of materials of varying sizes, ranging from sand to boulders, that fell from the mountain. For this reason, miners search their concession areas for large rocks, known locally as *batu gajah*, which are then crushed by machinery to produce concrete. The mining company thus relies on geological formations from the distant past and on villagers bearing the current and future risks of extraction.

– Unsustainable development in rock mining sites

Mining activities produce several socio-environmental impacts on villagers. Rock mining produces dust that pollutes the air and causes acute respiratory infections among residents in the surrounding kampungs. The dust also settles on leaves, damaging crops and other vegetation. Before mining began, residents harvested sugar apple (*srikaya*) every three months. Since the mining boom, many plants in Watusampu, such as mango and sugar apple, have ceased producing fruit, and residents now harvest none. Rock mining has also caused two types of water-related risks. First, it has heightened the risk of flooding. During the rainy season, water flows down from the mountains along mining and hauling roads, inundating lowland areas. Second, excavation activities on the cliff have led to the disappearance of many springs that previously emerged from it. In addition, the loading of rocks at jetties produces noise that makes it difficult for people to sleep at night (interview with head of Watusampu village, 3 April 2023).

The demand for water was gradually addressed through the installation of local piped water networks by the Palu municipal water company at the time of fieldwork. The noise problem was addressed by regulating loading times, which were restricted to end by 10 pm. Problems related to dust, flood risk and the disappearance of the springs remain. As of the time of writing (2023), mining companies were addressing the damages and risks caused by their activities through monetary compensation. Each month, each company contributed IDR 3 million as a so-called 'contribution' fee to the village treasury. In addition, for every shipload of stone that left Watusampu, the village received IDR 2 million. On average, Watusampu Village received IDR 90 million per month from these contributions and ship payments.[13] The contribution fees are managed by a designated villager. In the past, the money was used to build fences for houses along Palu Bay, both for beautification and to protect them from tsunamis, such as the one in 2018 that flooded their yards and houses with debris from the sea (interview conducted with the villager who managed the contribution fee together with three other villagers employed by the mining company, 8 April 2023).

What will happen in terms of environmental restoration after a rock mine is closed—which occurs after approximately seven years, based on the estimated mineable reserves discussed above—remains unclear. This uncertainty stems from the fact that many rock mines began production without government permits, which require detailed environmental impact assessments and post-mining mitigation plans.[14] Hence, in terms of the time dimension of this operational landscape, villagers are forced to pawn their future to uncertainties in environmental conditions during and after mining activities,

13 The average monthly amount of IDR 90 million was the sum of contributions from rock mining at the cliff and sand mining at the river. The latter, however, accounted for only a small portion of the total (Interviews conducted with the villager designated to manage the contribution fee together with three other villagers employed by the mining company, 8 April 2023).

14 Source: letter from the Central Sulawesi Ombudsman to the Mayor of Palu, 2017.

while mine owners reap the primary benefits. Both the present and future of the villagers become sinks for environmental impacts, a hidden time-abode for the rock mine.

The circulation time of mined rock, therefore, encroaches on both past and future as its hidden abodes. To ensure the targeted turnover time for capital invested in rock mining production, a stone-carrying ship may dock in Watusampu for a maximum of three days. A longer harbour time increases the turnover time, reduces the number of turnovers, and lowers profit (on circulation time and the number of turnovers, see Marx, [1885] 1978: 233–6). For this reason, the harbour time of ships in Watusampu's docks is regulated by the government and enforced by the tax agency. Loading must be completed within three days; otherwise, a fine of IDR 15 million per day is levied on each ship.[15]

All parties benefit unevenly from this regulation. The villagers ensure the flow of mining companies' contributions to the village treasury while also absorbing current and future risks into their lives. The government secures a consistent inflow of tax revenue. This regulation also enables mining companies to control the circulation of commodity capital, in this case stone. The uneven development in the zone of rock extraction in Central Sulawesi is therefore operationalized to fulfil the needs of the ongoing sociospatial concentration of construction associated with the IKN as a sustainable city in East Kalimantan.[16]

Conclusion: addressing uneven and unsustainable development caused by sustainable urbanization

In this article, we have analysed how the sustainable urbanization of the new capital city in East Kalimantan produces uneven and unsustainable development elsewhere, specifically at the source of stone in Central Sulawesi. The development of IKN requires not only human labour as 'resources', but also non-human resources such as stone. This requirement reproduces the operational landscape in Central Sulawesi, entrenched in the geological time formation of the extracted rock, the social reproduction of exploited labour, and the capital reproduction of investment. We describe these translocal processes as the unsustainable development of the operational landscape: developing sustainability at one pole means producing unsustainability at the other. We have framed our analysis through a combination of theory on the uneven development of translocal geographies and the operational landscape of planetary urbanization to question the privileging of the 'city' in urban studies and planning.

Methodologically, we have critically examined the claim of sustainability of the city by following the flows of rock. By treating rock as a temporal actor, our theoretical contribution lies in identifying 'the diverse ways in which places relate to time' (Bunnell *et al*., 2022: 1083). We contribute to the sociospatial theory of planetary urbanization by explicitly inserting this temporal dimension. Since every production of space is 'thoroughly temporal in nature' (Kitchin, 2024: 1), we advocate for the systematic integration of temporal dimensions into urbanization studies, which can be pursued, for instance, through a longitudinal follow-up of the materials that constitute a city and its 'outside' (Conroy, 2024).

The pragmatic implications of our analysis for the ongoing development of Indonesia's sustainable capital city can be clarified in two interrelated ways. First, the impact of a large-scale project such as IKN does not stop at its spatial boundaries but extends into other areas, including other islands, for example, through flows of stone. The insertion of a temporal dimension into the sociospatial theory of planetary urbanization helps show how such impacts do not stop at the time of development but extend into infinity. This extension involves backward and forward time

15 Interviews with Watusampu residents, 8 April 2023 (see footnote 12) and with a government officer at Palu's revenue agency, 10 April 2023.

16 Data in this paragraph are summarized from an interview with 3 NGO activists (1 April 2023), interviews with the heads of Watusampu and Buluri villages (3 April 2024), and the interview with Watusampu residents (8 April 2023).

dimensions—into the geological past and into future ecological risks—depending on the capacity for environmental remediation and the efforts made toward it. For the people and landscapes at the rock mines in Central Sulawesi, the ripple effects of landscape operationalization may extend even further, as the rock mines are located on top of or near an active geological fault. This raises further questions: How does rock mining impact the geological fault? Will it accelerate the activity of the fault?

We advocate for the technical and strategic documents of sustainable urban megaprojects such as IKN to adjust to this logic by considering the spatial and temporal dimensions of urbanization. This requires an explicit analysis of the spatio-temporal impacts of the IKN project on near and distant environments and the inclusion and mitigation of these impacts within the new city indicators and planning frameworks. The latter should explicitly acknowledge that a sustainable urban development such as IKN is unevenly productive of unsustainability at its core: the exploitation of precarious labour in its development and the extraction of rock in an operational landscape at a distant place, whose condition of possibility is enabled by the hidden abodes of the turnover time of capital in the past, present and future.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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