Mining the miners: acknowledging the magnitude of mining deals through data science

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1 Introduction

Development through growth, promoted since the end of the Second World War in 1945 and the enactment of the Marshall Plan, have been disparaged for a while [4], but has recently gained prominence [3]. A way of life, mainly based on petrol use is increasingly contested [1]. Globally, many advocate for a sustainability transition [8]. This catch phrase is receiving increasing attention and generates enthusiasm across a range of actors, from civil society to financial authorities [5]. Hence a wide consensus has emerged around this paradigm and proponents advocate for more sustainable modes of production and consumption. Discourses from industry leaders and politicians are embracing these rightful intentions,but for now it is too early to tell if it will translate into a greening of capitalism while promoting new consumption patterns, or if it will lead to envisaging deep-structural changes in the system [2,7]. Proposed pathways for an ecological transition are directed towards an energy transition. The mining is then expected to boom with the growing demand for mining goods in the current context of Technology (forthcoming 5G will require rare earth in greater numbers) and energy transition [6]. Increasing the number of mining schemes will cause loss for land that could have been devoted to food crops, and increase in agricultural products' prices on local markets. Access to food might also be more difficult for local populations due to the loss of agricultural sovereignty. This situation might lead to increasing tensions between elite owners and small producers and eventually engender greater political instability. To anticipate the changes and impacts to come, it is important to acknowledge past and current trends in the global mining sector. Here, we derive data from mining deals registered in the Land Matrix[1].

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[1] https://landmatrix.org

Table 1 Structural characteristics of the mining land trade network.

#nodes	*#edges*	*reciprocity*	*avg_path_length*	*avg_cc*	*transitivity*	*assortativity*
66	142	0.0	3.09	0.05	0.01	−0.14

The Land Matrix is an independent global land monitoring initiative, with particular attention towards transparency and accountability in decisions over Large-Scale Land Acquisitions in low- and middle-income countries across the world. The information collected in the Land Matrix database comes from heterogeneous sources such as press articles, government data, individual contributions and scientific publications. In this work, we model a mining land trade network in order to allow the application of data mining and network analysis techniques, with the aim to better characterize relations among countries and help to understand the dynamics of the land trade market for mining deals.

2 The mining land trade network

In our mining land trade network, nodes represent countries, and an edge (u, v) means that a company from country u has at least a mining deal involving country v as target country. Edge weights model the number of deals between the two countries. Furthermore, in order to characterize (and quantify) the role of each country in the network (e.g., as investor, target, or both) we define the *M-score* as the weighted in/out degree ratio of each node. Intuitively, a high score will correspond to target countries (i.e., high number of incoming deals) and a low *M-score* to investor countries. The *mining* land trade network is reported in Fig. 1, with countries colored based on their normalized *M-score*, and edges opacity proportional to edge weight. Structural characteristics of the network are reported in Table 1.

The main structural characteristics of the global land trade network are reported in Table 1. A relatively low average path length on the undirected graph (3.09) indicates that the land trade network is rather compact, even if the average clustering coefficient (computed on the undirected network) of 0.05 is relatively low, indicating a low density of connections. It is interesting to note how the network shows a null reciprocity (0.0), emphasizing how it is quite uncommon to have reciprocal investments in mining deals between countries. This low value is not surprising, and can be seen as a quantitative assessment of an asymmetry in the land trade network which can be considered as a direct heritage of the colonial power. The same observation about the asymmetry of the land trade market holds when looking at the rather low transitivity (0.01).

The map in Figure 1 shows that land deals are mainly located in Central America, South America, Africa and South Asia, where the Global North and BRICS are relocating extraction of minerals and related pollution. Clear patterns and country profiles can be observed in the map. For instance, Mexico, Argentina, Mauritania and Tanzania have a *M-score* close to 1.0, which il-

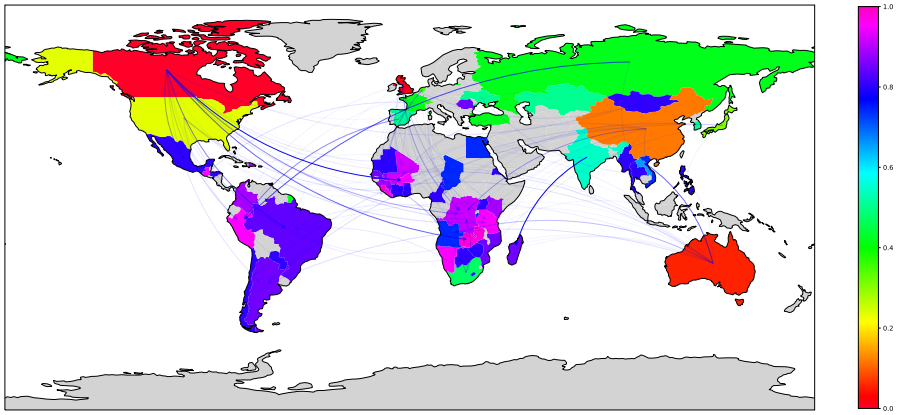

Fig. 1 Mining land trade network. Countries are colored based on their normalized M-score, and edges opacity is proportional to edge weight.

lustrates their propensity to attract investments. On the other hand, we can see how the main investors in the mining sector (i.e., *M-score* close to 0.0) are countries like Canada, Australia and United Kingdom. Many countries in Africa or Middle East are not referenced as part of the mining network. Nevertheless, it is important to note that most developing countries are partly entangled in the network and attract investment, as much as they invest in other countries. With the race to rare earth elements that is accompanying the development of "green" energy, this baseline will help to monitor the dynamics of mining activities.

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