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The New Abnormal: Identifying and Ranking Anomalies in the Land Trade Market

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1 Introduction

Large-scale national and transnational commercial land transactions, or Large-Scale Land Acquisitions (LSLA), are a global and consolidated phenomenon that plays an important role in basically every land-based business, including agriculture, forestry, mining, tourism, renewable energy, and many more. Even though such phenomenon has long been noticed, a sudden increase of such kind of deals has been witnessed in recent years, mainly due to the long lasting impacts on the global markets of the worldwide financial and food crisis that took place in 2007/2009.

A major point of discussion about this controversial phenomenon is to what extent these large scale investments have a positive impact on the economies of the target countries, in fact, they leverage valuable economic opportunities, while on the other side of the coin there exists a significant risk of corruption and impact on indigenous people's livelihoods and habits (e.g., loss of land, marginalization). The relations among the countries involved in LSLAs are often deriving from ancient colonial power, so that the predominant dynamic of the land trade market is certainly the one that reflects the power asymmetry between Global North and the Global South; for instance, G20 countries investing in southern ones (e.g., Sub-Saharan Africa, Latin America, South-eastern Asia).

However, recent research work based on complex network analysis techniques [1, 2] confirmed that other important dynamics exist in the global land trade market, such as a South-South one (e.g., Latin American countries investing in Africa), and the one involving emerging economies, such as the so-called BRICS countries (Brazil, Russia, India, China and South Africa). More specifically, in [2] we defined the *LSLA-score*, a topology-based measure proportional to the ratio between acquired and sold land for each country, which allows to rank the countries based on their investing/target role in the land trade network. It was found that, while extreme values of the *LSLA-score* characterize well-known dynamics, i.e., investors located in the Global North (low values) and target countries located in the Global South (high values), medium ones often correspond to emerging economies (e.g., Brazil, South Africa). While these countries tend to have an *investor* profile, they are also involved as target countries in several deals. The aim of this work is to perform a deeper investigation on these intermediate country profiles, that can be considered as *anomalies* in the land trade market; notably, less than 25% of the countries included in the transnational land trade network are characterized

by this double investor/target profile. To this purpose, we will rely on *open access data* about LSLAs included in the Land Matrix database (https://landmatrix.org), which will be modeled as a network graph were nodes represent countries, and an edge between two countries is drawn if there exists at least one LSLA deal.

2 Ranking anomalies with the LurkerRank method

In order to identify and rank such anomalies, we will adapt a concept originally conceived in the context of Online Social Network (OSN) analysis, that of *lurker*, by exploiting the *LurkerRank* (LR) method [3]. A lurker can be defined as a rather silent user, who gains benefit from others' information and services without giving back to the OSN through tangible actions. LR is an eigenvector-centrality-based ranking method that exploits the topological characteristics that derive from such participation inequality in order to identify and rank lurkers in a network graph.

Our hypothesis is that the OSN-inspired principles on which LR is based on can be adapted to the context of a land trade network, which models the flow of acquired/sold land between countries instead of the flow of information in an OSN. Note that, in order to be suitable for the LR method, in this work we use a land trade network graph that has an inverted topology w.r.t. the one used in [2]: the direction of an edge will follow that of the ownership of the land, i.e., from the target country to the investor one.

The three main principles underlying LR can be summarized as follows [3]:

- **P1**. Overconsumption, i.e., the excess of information-consumption over information-production.
- **P2**. Authoritativeness of the information received, i.e., the valuable amount of information received from its in-neighbors.
- **P3**. Non-authoritativeness of the information produced, i.e., the non-valuable amount of information sent to its out-neighbors.

In the context of the identification and ranking of anomalies in the land trade market, we revise the above principles as follows:

- **P1**. Excess of acquired land over sold one. Actually, in the context of LSLA, the sole presence of deals on both sides is an indicator of anomaly (i.e., even in absence of an *excess* of deals on a specific side).
- **P2**. The amount of land acquired from countries with a stronger investor profile (e.g., "richer" countries).
- **P3**. The amount of land sold to countries with a stronger target profile (e.g., "poorer" countries).

The aim of this work is to study to what extent such principles are verified on the real world data about LSLA provided by the Land Matrix database, and to deeply investigate which country profiles may correspond to such anomalies (e.g., emerging economies, tax havens, countries that lay at the border between different political/strategical areas).

3 Preliminary experimental results

The network used for the experiments has been built starting from a snapshot of the Land Matrix database obtained on July 2021, and includes 149 nodes (each one representing a different country) and 715 edges. Given two nodes/countries u and v, a directed edge (u,v) exists if there is at least a deal where a company based in v invests in a deal where u is the target country; weights are computed as the total size (in hectares) of the deals involving u as target and v as investor country. On this network we will apply three different variants of LR [3], which differ for the principle they give more importance to during the ranking process, namely **LRin** (P2), **LRout** (P3), **LRin-out** (all principles).

Table 1 shows the top-10 ranked countries for the three variants of LR, together with their ranking scores. It can be noted how the three variants result in significantly different rankings. Some similarity can be observed between *LRin* and *LRin-out*, since 7 out of 10 countries appear in both top-10s, even if at different positions in the ranking. Conversely, *LRout* and *LRin-out* only have 2 top-10 countries in common, and none can be observed between *LRin* and *LRout*. From a qualitative point of view, it should be noted that all the BRICS countries appear at least in a top-10, confirming how these emerging economies play a different role w.r.t. classic Global North and Global South countries, and hence they can be seen as anomalies in the transnational land trade market.

	LRin		**LRout**		**LRin-out**	
rank	*country*	*score*	*country*	*score*	*country*	*score*
1	South Africa	0.0014	Indonesia	0.4237	China	0.8265
2	Mauritius	0.0011	Argentina	0.2709	Malaysia	0.0266
3	Kazakhstan	0.0008	Russian Federation	0.1565	India	0.0141
4	India	0.0005	Brazil	0.0923	Kazakhstan	0.0082
5	Lithuania	0.0004	Malaysia	0.0270	Chile	0.0012
6	China	0.0002	Vietnam	0.0151	South Africa	0.0009
7	Malaysia	0.0002	Nigeria	0.0041	Argentina	0.0003
8	Sri Lanka	0.0001	Ghana	0.0021	Lithuania	0.0003
9	Jordan	0.0001	Zimbabwe	0.0021	Indonesia	0.0003
10	Belize	0.0001	Mexico	0.0013	Sri Lanka	0.0002

Table 1. Top-10 countries and ranking scores as ranked by *LRin*, *LRout* and *LRin-out*.

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