THE MODERN AGRICULTURAL FRONTIER AND LOGISTICS: THE IMPORTANCE OF THE SOYBEAN AND GRAIN STORAGE SYSTEM IN BRAZIL

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Abstract *This article analyzes the central role of logistics in soybean and grain production on the modern agricultural frontier in Brazilian territory, highlighting the strategic role of the storage system. The restricted control and selected location of the storage units contribute to the regulation of the crops produced by large companies, as they hinder the application of agricultural supply policies by the Brazilian State.*

Keywords *Modern agricultural frontier, soybean and grain storage, logistics, agricultural supply policy*

Introduction

The recent expansion of grain production in the Brazilian Cerrado (a vast tropical savanna ecoregion) has been calling for the implementation of efficient logistics, especially for the transport of the crops. Logistics, within a geographical perspective, can be understood, as Castillo (2007) proposes, as a set of operational, normative and infrastructural competences. Regarding the modern agricultural frontier, many proposals have been made for the creation of intermodal transport systems (roads, waterways, railroads) and guide-lines and operational strategies have been proposed to diminish the problems involved in the exportation of crops with a view to reducing the time and consequent cost of their transport.

The storage system is one of the most important elements in the agribusiness chains. It allows the application of efficient logistics of grain distribution over time and space, attenuating the seasonality of agricultural production (crops and intercrops) by staggering the grain outflow over the year and distributing stocks more effectively between producing and consuming areas.

With the expansion of the modern agricultural frontier, access to the storage system has become increasingly important due to the ever greater distances between producing areas and export ports and to the varying reliability of the existing transport systems.

Since the 1990s, policies favoring privatization and reduced State intervention have led the large companies of the world grain trade, known as trading companies, to start supervising the storage units. Since then, the restricted use and selective location of the storage capacity have disturbed Government supply policies and allowed greater control of production by large companies (Frederico 2010).

This study analyzes the expansion of the modern agricultural frontier in areas of Cerrado, on the basis of the above facts, and in view of the outstanding importance of logistics for the purpose of making production feasible, emphasizing the typology, the topology and the control of the grain storage system. In conclusion, the way the lack of State storage units and the unsuitable location of existing warehouses hinders the implementation of public supply policies is highlighted.

Modernization and expansion of the agricultural frontier

Those areas of the Brazilian territory occupied, since the 1970s, by capital-intensive and high technology monocultures, in place of the original vegetation (mainly Cerrado), the traditional crops (cultivated by peasants and/or household farmers) and extensive pasture areas, constitute what is known as the modern agricultural frontier.

Motivated by geopolitical and economic factors, the expansion of the modern agricultural frontier has occurred mainly in areas of biome Cerrado, also known as "the acid soil polygon" or "interior tropical plateaus", which correspond, according to Ab'Saber (2003, p. 117), to one of the "largest irregular polygons that form the Brazilian landscape mosaic". Occupying an area equivalent to a quarter of Brazilian territorial extent, the Cerrado is characterized by conditions both topographical (plateau, with large flat areas and deep soils) and climatic (two well-defined seasons, one rainy and the other dry, and intense luminosity) favorable to modern agriculture.

At the first moment, the State was the chief promoter of the expansion of the modern agricultural frontier by providing subsidized credit for producers, cooperatives and agro-industries, incentives for the creation of public and private colonization projects, the development of cultivars adapted to the climatic conditions of the Cerrado and the construction of transport systems to make the outflow of the production viable. The main objectives were to: integrate the national economic space, occupying the "territorial funds" (MORAES, 2000); increase soybean and grain production so as to meet domestic needs and increase the exports of a country undergoing rapid urbanization and industrialization, and guarantee the integrity of the national territory, occupying the border areas by transferring settlers to them from the more densely populated areas and from those facing serious agrarian conflicts.

The shrinking of the "territorial funds" and the implantation of modern agriculture in the southern Cerrado has permitted a kind of "primitive accumulation of capital", which has benefited big producers and multinational companies, has increased the area under cultivation and the quantity of soybean and grains produced, expanded the exportation of agricultural commodities and transferred a large population contingent, promoting the distribution of land without undertaking any real agrarian reform (Graziano da Silva 1981).

Since the 1980s, the fiscal crisis and the adoption, even though partial, of the Washington Consensus, have reduced the role of the Brazilian State as an important player in the spatial productive circuits and in the modernization and expansion of the agricultural frontier. Despite this, the Government is still important (for private companies) in matters such as infrastructure (railways, waterways, ports), agricultural credit and the development of new cultivars.

In the relative absence of the State, the large companies of the world grain trade have gradually taken over some of the former's functions. The companies participate mainly in strategic activities such as agro-industrial processing and the control of the material aspects (storage, benefaction, transport, sale of seeds and fertilizers) and non-material circulation (financing, trade, exportation, capital funding).

Trading companies, besides controlling the transport of soybean and grains and their products from the productive areas to the consumer markets, also establish circles of cooperation (Santos & Silveira 2001), that is to say, information flows (orders, messages, capital funding) between many agents (big producers, brokers, logistic companies and the State) and distinct places (agricultural frontier areas, command cities, export/import ports and consumer centers). These cooperative circles are essential for the creation of the connections between the several spatially separate production stages as they articulate the agents and places involved in the spatial circuits of production (Santos 1986; Castillo, Frederico 2010).

With the increase in the volume of the flow of crops and the greater distances between the

production stages (production itself, distribution, exchange and consumption), logistics has become a privileged field of action of the large companies. The control of the infrastructure and the logistic operations make the companies more competitive, conferring greater productive efficiency and prominent insertion in the international trade. Thus, logistics can be understood, as Castillo (2007) proposes, as a geographical expression of corporate circulation in the current globalization period.

The centrality of logistics on the modern agricultural frontier

Knowledge of logistic activities is very old – originally the term referred to the rapid, efficient deployment of troops and supplies in wartime. During the Second World War, it was applied in many other fields, especially economics (Christopher 1998).

The emergence of the current period of globalization (Santos 2000) in the 1970s – characterized by the articulation between a hegemonic neoliberal policy, the diffusion of the new information and communication technologies and the flexible regime of accumulation (Harvey 1996, Benko 2000) – has led to profound changes in the concepts, practices and technologies related to logistics. The increase of material and immaterial flows and the enlargement of the productive spatial circuits – at least for a few products and regions – have made logistics an important means of cost reduction and a competitive tool of the large companies.

Within the perspective of economics and business administration, the notion of logistics is not restricted to the transport and storage of goods and products, it also describes a series of other activities, such as the rendering of services to clients, the aggregation of value to products, cost reduction, marketing, order processing, maintenance, and the creation of stock, among other things, that need to be carried out in an integrated manner.

However, logistics is not restricted to the companies' operational strategies, it also relates to places, regions and territories. Within a wider processual theory (B.S SANTOS, 1988), geographical space is a hybrid of materiality (dead labor) and action (living labor), technique and rule, condition and conditioner of social reproduction (SANTOS, 1996). Castillo (2007) proposes, as already stated, that logistics now should be considered a geographical expression of corporative circulation. It is defined by the bringing together, in a given subspace, of technical systems (transport infrastructure, storage, communication), rules (political, juridical, cultural, economic) and operational competences (knowledge, information), that confer fluidity and competitiveness to the economic agents and productive spatial circuits.

Logistics plays a central role in modern agricultural production. The predominance of the logic of commodity trading, expressed by the standardization and international regulation of production, has been promoting the deepening of the territorial division of labor, leading to regional agricultural specialization. The enlargement of the agricultural productive spatial circuits has integrated the flows on a global scale, calling for ever further-reaching logistics in the linking up of the stages spatially separate from production.

The case of Brazil is still more significant, seeing that the expansion of the modern agricultural frontier has increased the distances between the productive areas and the main export ports and consumer centers, making the logistics more complex. Apart from distances, there are other factors which contribute to hindering the outflow of produce, among them being the poor condition and inadequacy of the transport systems, concentrated in the South-central region and focused on road haulage, and the concurrent increase in the area under cultivation, the quantities produced and the productivity.

On the modern agricultural frontier, the logistics of the agro-industrial system in great part match the existing transport systems to make the territorial fluidity (Arroyo 2001) of the soy crop viable. To make its production practicable, infrastructure systems have been planned and built by the State and private companies, especially for storage and grain transport. The most onerous works, such as the construction, expansion and modernization of roads, railroads, inland waterways and ports, are mainly undertaken by the State and then conceded, in the majority of cases, to big transport and trading companies.

Among the infrastructure and transport systems controlled directly by trading companies and deserving of mention are the Madeira River waterway and the ports of Porto Velho/RO and Itacoatiara/AM, managed by Amaggi (the main national capital trading company) and the port of Santarém/

PA, managed by Cargill. Both facilitate the outflow of the grains produced in the states of Mato Grosso and Rondônia.

As for the partnerships between trading companies and the logistics and transport companies the following are worthy of mention: the investments made by the Maggi, Bunge and America Latina Logistica (ALL) companies in the construction of the Guarujá Granary Terminal (TGG), at the port of Santos (the largest terminal for the reception, storage and shipment of agricultural grains in Latin America); the partnerships between ALL, the administrator of Ferronorte (the main railroad for the outflow of the grains of the Mid-Western region), and the trading companies Cargill, ADM and Maggi; the cooperation between the company Vale, the controller of the Carajás and Norte-Sul railroads, and the Cargill and Bunge companies, for the purpose of facilitating the flow, through the port of Itaqui/MA, of the grains produced in the states of Maranhão, Piauí and Tocantins; besides the new infrastructure projects planned and built by the State and assigned to the large private companies, such as the extension of the Ferronorte railroad (as far as Rondonópolis/MT and Cuiabá/MT) and the Norte-Sul line (into the state of Goiás) and the construction of the Nova Transnordestina and Oeste-Leste railroads.

Another strategic policy adopted by the trading companies is the control of the soybean and grain storage system. This is essential for the preparation of the grain (cleaning, phytosanitary treatment and bulk conservation) and the sequencing of its dispatch, avoiding overloading the transport systems and staggering the freight peaks. With the privatizations, the increase of the grain production and the expansion of the agricultural frontiers, the state warehouses – predominant by the 1980s – have become insufficient and inadequately located. The large companies have, since then, come to be the players mainly involved in storage, chiefly on the modern agricultural frontier. The lack of State and farm silos makes the producers dependent on the trading companies. They are obliged to make use of their infrastructure, selling the soybean grains either in advance or during the harvest period (at the consequent lower prices and higher freight charges), thus laying themselves open to doubtful practices as they face the risk of not being able to transport their produce and may end up losing the grain by deterioration.

The strategic importance of the grain storage system

The need for storage is present in all the stages of the spatial productive circuit (production, distribution, exchange and final consumption). The functions of a storage network include receiving the grains and cleaning them up, undertaking the phytosanitary treatment, conserving and later redistributing them.

The storage network is important not only for the outflow of the grain crops, but also for the expansion of agricultural production and the implementation of grain producing policies. The existence of an integrated system, with efficient circulation logistics, allows a chronological distribution of the products and prevents the oscillation of prices due to the seasonality of production. Besides seasonal variations, which occur annually, there are also interannual variations caused by the weather oscillations or by lack of incentives for the producer (seen in the drop in grain prices). The creation of long-term stocks avoids sudden price fluctuations, allowing the balance of supply and demand.

Besides the regulatory stocks there are also the strategic stocks, formed with the geopolitical objective of guaranteeing the grain supply during a period of war or, as Raffestin (1993: 255) points out, being used as "political weapons" in the relationships between nations. In the Brazilian case, there is no kind of strategic stock and the regulatory ones became practically extinct in the 1990s.

At the beginning of the 2000s, the State created financing programs for private initiative for the construction and modernization of warehouses, known jointly as the Program of Incentives for Irrigation and Storage (*Programa de Incentivo à Irrigação e à Armazenagem – Moderinfra*). Following the incentive programs enacted by the Government, the Storage Law was, further, promulgated in 2001 for the purpose of modernizing and regulating grain storage. This Act has established rules of storage quality standardization, permitted that general warehouses participate in the grain trade, regulated the commercial relations between depositor and depository through the Arbitration Chambers and obliged the warehouse owners to register information about their warehouses and the stocks deposited in them.

As a consequence of these measures and also of the action of the trading companies on the

agricultural frontier, the storage deficit in Brazilian territory has been greatly decreased. However, the current storage capacity has improved only relatively. Trading companies, which hold the highest static capacity, mainly on the modern agricultural frontier, are selective about the products they stock. They normally give priority to the soybean bound for export, that yield them higher returns, as in the case of soy, to the detriment of grains considered "anti-economic" and bound almost exclusively for the internal market, such as corn.

Typology, topology and control of the soybean and grain storage system

An analysis of the grain storage system must take into consideration its typology as an integral part of the system, that is to say, its main technical characteristics, and the topology of the system, expressed by the strategic and selective location of the technical objects and their use, as defined by the agents that control the network.

Warehouses / storage unit typology

Basically, there are two main classes of storage unit: the conventional warehouse and that for grain (Weber 2005). Besides their technical specifications, their size, type of building, ventilation system, application and hermeticity are also important.

Conventional warehouses store only bagged products. They are one-story buildings, rectangular in shape with no equipment appropriate for loading and unloading grains. They are used for keeping seeds, manure, fertilizer, agricultural machines and vehicles, and for the storage of castor-oil plants, sunflower seeds, beans, processed coffee, rice, peanuts, cotton (core) and sugar. This kind of storage unit was predominant in Brazil up to the 1970s, due to the intensive production of coffee and sugar. From then on, however, with the increase in grain production, mainly of soy and corn, they have been gradually replaced by grain warehouses.

Grain silos and warehouses are more complex, modern structures than the conventional warehouses, as they have mill hoppers, cleaning machines, dryers, ventilation systems and elevators, allowing for the better cleaning, classification and conservation of grains. The silos constitute real information systems (Aracri 2005): all the storage stages are controlled by computers, from the hydraulic dumping command to the trucks, the mass drying and the cooling operations to the dispatch of the grains.

The grain type is more agile in the transshipment of grains and avoids proliferation of insects, rodents and microorganisms, common in conventional warehouses. These characteristics provide a clean uniform product and maintain its nutritional qualities. From the economic point of view, according to Puzzi (1986: 41), grain warehouses offer many advantages, they: reduce losses, estimated at 10% in the conventional units; allow grain storage for long periods; offer detailed information about the product and effective control of stocks. The chief products stored in grain warehouses are: oats, rye, barley, corn, soy, sorghum, wheat, triticale and rice.

Nowadays, grain silos are responsible for slightly over 80% of Brazilian storage capacity, corresponding to a static capacity of 112.3 million tons, distributed among 10,403 units; conventional warehouses account for 25.4 million tons in 7,065 units (CONAB 2007).

Warehouse topology

As regards location, the storage units can be classified under four types: farm units, collecting units, sub-terminal units and terminal units. The existence of farm units ensures the autonomy of the producer, who decides on the moment to sell and make his produce flow, and diminishes the power of the large companies. In accordance with Weber (2005, 318), noteworthy among the main advantages of the farm units are: a smaller overload of the transport system in the harvest season; previous knowledge of the total weight of the product harvested and delivered to third parties; permanence, on the property, of the grains that will be used on the farm itself, avoiding return transport to the benefaction plant; utilization of any organic waste by the producer himself, and the qualification and remuneration of the local and household work force.

The collecting units are located in the big and medium-sized producing regions and must be able to collect and process a significant part of the production of their area of influence. In the South

region of Brazil, the majority of the collecting units belong to the cooperatives and their associates; on the modern agricultural frontier, the large exporters and grain processing companies exercise the control. The flow of the grains at the collecting units, linking the agricultural property to the sub-terminal units, must be extremely efficient in view of the high turnover.

Sub-terminal units are larger and more complete technical systems than those mentioned above. They receive grains from the several collecting units or direct from the farms and distribute them either to the terminal units or directly to the final consumer. Sub-terminal units are located near the consumer markets, generally on urban outskirts, whence the products are taken to terminal units (bound for exportation) or consumed in the region itself.

Finally, terminal units receive flows coming from the entire national territory and from other countries with the objective of exporting and importing products. These units are located at export terminals or river ports. At the beginning of the 1990s, the terminal units were under government control, but since the creation of the Ports' Modernization Law (1992), private companies have been building large terminal units at the main ports such as Santos (SP) and Paranaguá (PR). Besides port units, warehouses of the grain processing companies are also considered to be terminals and are generally located near the consumer markets.

The four types of storage unit (farm, collecting, sub-terminal and terminal) must all be integrated into a network, allowing the fast, continuous flow of information and goods. Their size and location must contribute to avoiding the overloading of the other units through a more even distribution of grains.

Despite the various advantages of the farm units, they represent only 15% of the national storage capacity, differently from those of other countries and regions of large agricultural production such as: the USA (65%), Argentina (40%), the European Union (50%) and Canada (80%) (Conab 2007). In these countries, storage logistics and grain transportation obey a sequence that starts on the farm and evolves to the collecting, intermediate and final systems, avoiding any overloading of the terminal units chiefly in the harvest season.

In the Brazilian case the situation is the opposite, the historically agroexporting character of the system having led to the prioritization of the construction of warehouses in urban and port areas, which overloads the system downstream. Nowadays, about 50% of the national storage capacity is concentrated in urban areas (sub-terminal units), 30% on the roads near the farms (collecting units) and 5% in the port areas (terminal units). In other words, 85% of the static storage capacity is located beyond the farm gate, which leads to the depreciation of the value of the products and causes qualitative and quantitative losses of the grains in such a way as mainly to burden the producer.

Storage system control

Storage units may be for public or private use. It is noteworthy that in the former case the warehouses are administered by the cooperatives or by the State (in this case, managed by the National Supply Company – *Companhia Nacional de Abastecimento – Conab*). As for the private warehouses, they generally belong to the producers, agro-industries, specialized storage companies (general warehouses) and trading companies. By the 1980s, this situation had changed with the privatization of some part of the State units and the policies of the trading companies and big agro-industries involved in the administration of storage.

On the modern agricultural frontier, the participation of the trading companies in storage is still more significant. These companies control the larger part of the static capacity, located in the main productive cities and export ports.

In the city of Sorriso (MT), the major national grain producer, with yields above 2 million tons a year, the private companies control about 80% of the installed capacity. The national companies Sipal Industry and Commerce, Santa Cruz General Warehouses, Maggi and Daroit General Warehouses, together with the multinational Bunge and Cargill, control about 50% of the total capacity of the city.

In Sapezal (MT), the restricted control is repeated, 82% of the storage capacity being controlled by private companies. The Maggi Group, a company of the city's founding family, alone holds a static capacity of about 280 thousand tons, about 20% of the total amount. The transnational companies Bunge and Cargill, as in all big grain-producing cities, also have considerable participation, controlling about 10% of the city's total capacity.

In the city of Uruçuí (PI), 85% of the static capacity is controlled by private companies. The multinational Bunge is practically the only large company, alone controlling about 60% of the city's storage capacity.

In Balsas, an important grain production center in Maranhão, private control of the storage system is even greater, with 97% of the total capacity under the companies' control. The trading companies Ceagro, ABC Inco, SLC Agrícola, Multigrain, Bunge and Cargill control 82% of the total storage capacity, against only 3% of the producers'.

In Barreiras and Luiz Eduardo Magalhães, two important grain-producing cities in Western Bahia, private companies control about 50% and 75%, respectively, of the total storage capacity. In the former city, Cargill has a static storage capacity of 151 thousand tons, equal to 25% of the total capacity. In the adjacent city, Bunge controls about 50% of the total, with static capacity of more than 550 thousand tons. In both cases the considerable growth in the percentage of warehouses controlled by producers and cooperatives over recent years, mainly farm units, is noteworthy and amounts to approximately 50% of the total static capacity in Barreiras and 25% in Luiz Eduardo Magalhães.

The Bunge and Cargill Companies have, individually, the two largest static storage capacities in Brazil, with 5.8 and 4.1 million tons, respectively, distributed in tens of cities extending from the agricultural regions to the main exporting ports. The topology of the storage capacity demonstrates the ability of these companies to use the territory as a resource, because, for them, the national territory offers the possibility of attaining added value (Santos, Silveira 2001). Places are seen as strategic points, necessary for the reproduction of the firm on a global scale.

The restricted use of agricultural technical systems, mainly of the storage system, ends up enhancing the productive specialization of specific places still further, thus increasing their external dependence. The cities and regions of the modern agricultural frontier, in Isnard's words (1982, p. 34), have become true alienated spaces, i.e. "regions that owe to the external world, not only their creation and integration into the world market, but even the survival of their organization".

The storage system can be interpreted as symbolic of the "verticalities" imposed on places by large companies. The solidarity resulting from these verticalities is, for Santos (1996: 284), "obtained through circulation, interchange and control", and it places distant points in an inter-relationship. The decision as to the increase or decrease of the storage capacity in a particular place is taken in distant places, located, in the majority of cases, in foreign countries. The daily life of each place begins to be integrated into the logic of the grain world market directly, controlled, as demonstrated by Morgan (1979) and Charvet (2007), by a restricted group of companies.

Final considerations: agricultural supply policy and the storage system

Large companies impose their rules on the territory at the same time as they are ruled by it. Through their relationships, large firms modify the territorial configuration, adjusting it to their political and economic necessities. However, the territory, through its "rugosities", i.e. its material inheritance produced in former moments, modifies the new events. This inseparable relation between event and form, subject and object, is what makes space a hybrid (Santos 1996).

Faced with this relationship, large companies need to create a discourse that justifies the reorganization of the material base of the territory. For Santos (2000: 18), this is the "unified discourse" of the present period, firmly based on information and the power of money. For the author, the repetition of one and the same discourse, even if it be fanciful, ends up by producing an apparently solid base.

This is the case of the "unified discourse" regarding the volume of exports necessary to achieve the fiscal goals to be attained and to justify government policy. The "export imperative" is thus imposed and demands the construction of a material base in the territory such as will allow the necessary fluidity of the goods. It is within this context that many infrastructure projects have been built since the 1990s, including port terminals, railroads, roads and waterways – to favor the increase in exports, chiefly of primary products.

General and specialized media broadcast the need for the construction of these engineering systems as if they were for the benefit of the whole of society but they do not reveal their selective nature. On the other hand, the Brazilian territory

lacks the basic infrastructure which would allow the effective fluidity of agricultural products between its diverse regions.

This is one of the main problems faced by the public supply policies implemented by Conab. Huge grain transfers throughout Brazilian territory are necessary, annually, for the purpose of supplying the regions characterized by high demand and low grain production, but the lack of transport and storage infrastructure hinders the flow of the produce. The majority of these policies adopted seek to make the circulation of rice, beans and corn viable, due to the great importance of these crops to the Brazilian domestic trade. In the case of corn, only 5% of its production is destined to exportation. Despite its great importance for the internal market, especially for animal feed, corn has a much lower market price than soy, leading big producers and companies into avoiding large investments in capital and technology for its production.

This lack of interest on the part of these large companies creates problems for corn production especially as regards its transport and storage. The lack of warehouses on farms and of general warehouses of public use obliges many producers to stock grains without the necessary shelter, as well as causing an accentuated drop in prices during the harvest season.

To make the transport of grains from the big productive regions (Mid-West) to the regions with a supply deficit (North and Northeast) viable, Conab holds freight auctions, in which the company that offers the lowest bid wins the prize and assumes the responsibility for transporting the grains.

The big obstacle to the greater efficiency of Federal agricultural policies is the insufficient number of public warehouses. To get around this problem, Conab hires private storage providers, paying a rental for the space used. However, often the existing private storage providers do not comply with the technical conditions stipulated or they are simply not interested in storing public stocks or crops produced as a result of agricultural policies. Thus, even though the State has the resources necessary to intervene, it is still unable to control grain price oscillations.

Conab presently has 172 warehouses, with capacity to store slightly more than 2 million tons. Beyond being insufficient, as the Brazilian grain crop attained some 150 million tons in the 2009/2010 crop, Conab's warehouses, built mainly in the 1970s, have, consequently, been presenting problems as regards their location and technical structure. The public warehouses have not kept pace with the expansion of the agricultural production in areas of Cerrado, remaining concentrated in the South and Southeast regions, nor have they been modernized to enable them to store goods in bulk, warehouses of the conventional type still predominating.

The construction of warehouses at strategic points would contribute to establishing a better dynamic regarding the flow of the grain harvests, assisting small and medium producers and balancing the excess of supply in some regions. Without adequate infrastructure, the State is unable to balance the supply of and demand for grains efficiently among the diverse regions, as its storage units are insufficient and the private companies give priority to the exportation of commodities, in the case of soy specifically.

Therefore, the State must prioritize its supply policies and the logistics of internal food distribution, acting in such a way as to go against the large companies' and producers' "unified discourse" that only reaffirms the historically subordinate insertion of Brazil into the international division of labor, with a heavy onus on the territory as a whole.

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