# The insertion of Brazil in the global aluminum market: incorporating contributions from Political Ecology for Public Health

## A inserção do Brasil no mercado mundial de alumínio: incorporando contribuições da Ecologia Política para a Saúde Coletiva

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## Abstract

This article discusses the inclusion of Brazil in the global aluminum market from the theoretical framework of political ecology, political economy of the territory and collective health. The contemporary situation of world economy has been marked by deregulation and liberalization, characteristic of neoliberal ideals touted by the core nations. Brazil's larger share in this market has been held from the increased production and export of agricultural commodities and metals, like aluminum. In this sense, from the paradigms of political ecology, the paper proposes an analysis of social and environmental consequences, as well as of new territoriality that is produced and reproduced within a logic that privileges the economic core nations. Similarly, we seek to understand the dilemmas of collective health in a holistic and integrative perspective in which economic development models are articulated. It is noticed that the production and export of primary aluminum, despite having a greater aggregate value, hides a diffuse set of impacts that affect the environment and public health.

**Keywords**: Political Ecology; Territory; Production of Commodities; Collective Health.

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## Resumo

O presente artigo discute a inserção do Brasil no mercado mundial de alumínio a partir dos referenciais teóricos da ecologia política, da economia política do território e da saúde coletiva. A conjuntura contemporânea da economia mundial tem sido pautada pela desregulamentação e liberalização, característicos do ideário neoliberal propalado pelas nações centrais. A maior participação do Brasil nesse mercado tem sido realizada a partir do aumento da produção e exportação de commodities agrárias e metálicas, como o alumínio. Nesse sentido, a partir dos paradigmas da ecologia política, o texto propõe uma análise das consequências socioambientais, assim como sobre novas territorialidades que se produzem e reproduzem dentro de uma lógica econômica que privilegia as nações centrais. Do mesmo modo, procura-se compreender os dilemas da saúde coletiva sob uma perspectiva holística e integradora na qual se articula aos modelos de desenvolvimento econômico. Percebe-se que a produção e exportação de alumínio primário, apesar de apresentar um valor agregado maior, esconde um conjunto difuso de impactos que afetam o ambiente e a saúde coletiva.
**Palavras-chave**: Ecologia Política; Território; Produção de Commodities; Saúde Coletiva.

## Introduction

The aim of this article, based on a conceptual discussion centered on the contributions of political ecology, the concept of territory and social justice movements, is to shed light to achieve a better understanding of the relationship between economic models, characterized by commodity production, environmental conflicts and the public health of populations living in areas on which production processes impact. Brazil's inclusion in the global economy, following the process of globalization, has been characterized by the increased vulnerability of its territory and populations. Competitiveness in the external market is guaranteed by the externalization of environmental damage which places workers' and populations' health at risk. Throughout the text, we use the case of Brazil's inclusion in the aluminum market to exemplify this logic. To do this, the article is divided into five parts: the first and second discuss coordination between territory, public health and the current globalization process and environmental damage resulting from this process for the economies of peripheral countries such as Brazil; next, the concepts of ecological economics and social metabolism are presented; finally, aspects related to primary aluminum production in Brazil and socio-environmental impacts such as scenarios of environmental injustice are presented and discussed.

Over the last few years there has been a significant increase in the so-called global environmental crisis, a factor which has contributed to intensified concern surrounding the topic and has encouraged new ways of thinking about the environment. National and international agendas on the issue of the environment have been created in diverse fields of knowledge covering topics such as destruction of ecosystems, loss of biodiversity, increased pollution and global climate change. Public health is no exception. Understanding public health as an inter-disciplinary field founded on a wide and detailed understanding of health and the health-disease processes, committed to social transformation and tackling inequality, (Nunes, 1994; Paim and Almeida Filho, 1998), we consider it important to articulate new paradigms and fields of knowledge which are

critical and engaged, such as political ecology and environmental justice movements. Their importance lies in understanding environmental problems based on the conflicts produced by the way the global capitalist economy works, intensifying the flow of energy and materials, degrading ecosystems and life supporting systems, increasing socio-spatial inequalities and making disputes concerning natural resources, as well as those involving the values and meanings of economic development in the territories, more visible. We believe that dialogue between public health and political ecology provides a broader understanding of environmental issues and their relationship with health, ecology, economy, culture, human development, democracy and human rights.

The early years of the century have been marked by the globalization process and the environment is more than ever viewed as a storehouse of apparently infinite resources, although discourses of eco-efficiency, sustainability and green economy are being spread (Miranda and Porto, 2012). Beyond environmentalism viewing the causes and impacts of environmental problems to be equally distributed around the whole planet, critical visions supported by political ecology and social justice movements indicate that the exploitation of natural resources and environmental conflicts are unequally distributed among countries, territories and populations according to ethnic, racial, class and gender aspects (Acselrad, 2008; Acselrad et al., 2009). The contemporary situation of the global economy has wrought a (re) configuration of the international division of labor and riches: countries rich in natural resources, such as Brazil and Latin America as a whole, reinforce their position in international commerce as suppliers of rural commodities or metals (Porto and Martinez-Alier, 2007). At the same time as the production of these commodities in production chains, such as those of agro-business, iron-steel or bauxite-aluminum is responsible for maintaining trade surpluses, they leave heavy environmental impacts further up the chains, affecting ecosystems, traditional forms of economy and the quality of life and health of populations in territories involved in the production processes (Porto and Martinez-Alier, 2007). Such impacts are systematically left out of consideration when pricing these commodities, for this reason they are known as negative externalities. This means that for every ton of soya, iron, steel or aluminum exported, there is a trail of destruction in terms of the ecosystems and populations affected, including those in the fields and forests bordering areas of agricultural or mineral exploitation.

The position of peripheral and emerging countries as suppliers of primary and semi-finished products reveals a global logic of asymmetrical accumulation in the South-North direction, to the extreme advantage of the latter. According to Sousa Santos (2010), the South should be understood in a metaphorical sense according to the current logic of global capitalism, also including Asiatic nations, although located in the Northern hemisphere, as they can also be categorized as peripheral. Territories involved in production processes undergo metamorphoses which are determined and oriented according to external interests, characterizing their de-territorialization. In Brazil, agricultural production, large hydroelectric plants, mining projects and industrial and port complexes have transformed different territories based on foreign development models. They all have in common the fact that they are associated with global market interests, the principle function of which is to meet demands and patterns of consumption of the core nations and rich social classes. This production and commercial logic creates conflicts, placing large groups of national and/or international businessmen, agricultural families, workers and residents in peripheral neighborhoods, as well as traditional populations such as fishermen, *quilombolas* and indigenous peoples into different camps. Environmental conflicts in the territories exacerbate situations involving decreasing quality of life and traditional forms of development, producing health risks for the populations involved.

## Territory and Public Health in times of globalization

The coordination between territory, environment and health is ancient and was already present in the long ago work "Water, air and place" by Hippocrates in the 5$^{th}$ century BC, as well as in more recent works by authors helping give a scientific character to Geography, such as those by Maximiliano Sorre, in the

20th century. With regards to Brazil, two paradigms have been responsible for discussing the problem between health and the environment: biomedical and sanitation (Porto and Martinez-Alier, 2007).

The biomedical paradigm originates in classical parasitology based on the ecological model of infectious diseases. This approach has evolved over the last few years from the development of environmental epidemiology and toxicology which began to include environmental issues that are linked to chronic disease – such as cancers and heart disease –, constituting the theoretical base of a more technical approach to environmental health (Freitas, 2003). This paradigm is characterized by evaluating environmental risk and the connection to effects on health, albeit still limited with regards proposing solutions and interventions. Regarding the sanitation model, this is distinguished by a technical vision in which engineering models are the main solutions to certain environmental problems, such as structural sanitation works (water, waste and sewage) and management systems. The two paradigms have evolved with wider theoretical reference to sciences of risk without, however, incorporating an historical and dialectic vision of environmental conflicts, or dealing with these through more effective participation of the populations involved, such as workers and residents in contaminated areas.

An alternative model for understanding the relationship between health and the environment places emphasis on understanding the social and economic processes of development. This model originated in the environmental and social medicine movements which marked the birth of public health in Brazil (Freitas, 2003; Porto and Martinez-Alier, 2007) and is redefining the scope of the public health view beyond the biomedical paradigm. Through an historical and inter-disciplinary perspective, centered on social determinants of health, it seeks to incorporate other dimensions, such as political, economic, cultural and ecological which, in their complexity, enable populations' health problems to be understood in a broader way.

The coordination between social and environmental movements in the search for intervention processes which privilege promoting health have contributed significantly to the incorporation of new approaches to public health. For example, the ecosystem approach in health seeks to concatenate, in an inter-disciplinary and integrated way, theoretical knowledge and health and environmental practices in understanding health-disease processes and environmental sustainability (Sabroza and Waltner-Toews, 2001; Minayo Gómez and Minayo, 2006; Habermann and Gouveia, 2008). In public health in the USA, the work of Levins and Lopez (1999) indicates the need to incorporate more complex and critical-dialectic thought, through their proposal for an eco-social approach, combining activist science with movements for social and environmental justice beyond paradigms and political proposals such as social determinants and health for all.

Despite advances in constructing this new paradigm in the search for social integration in analyses of health and environmental problems, there is still a vacuum in relation to the search for better understanding between models of development and issues involving international markets and trade (Porto, 2007). The ecological economics paradigm has shown itself to be an important tool in the search for more accurate understanding of asymmetrical development relationships between countries. The ongoing globalization process has, especially in the last two decades, accentuated the role of peripheral countries as global commodity suppliers. Thus, a new International Division of Labor has been forged, leading to the incorporation of peripheral countries in the global economy in an antipodal relationship with the core countries. Their participation in the world economy, which can be described as what Sousa Santos (2007) call local globalism, is subordinate; to meet the demands of the Northern countries, those in the South specialize in producing agricultural and mineral commodities at the cost of eliminating traditional trades and subsistence economy.

At the same time as production and exportation of commodities in peripheral countries such as Brazil is becoming essential to maintaining a positive trade balance, it hides externalities which guarantee the competitiveness of these products in the international market. Between 2002 and 2010, the national export share of primary goods jumped from 24.8% to 47.6%, between January and June of 2011, if semi-manufactured exportations are added,

the percentage reached over 65% (Brasil, 2012). Thus, behind the tons of minerals, steel or aluminum exported lie ecosystems and natural resources and, above all, human lives which have been affected. In this scenario, inter-disciplinary fields such as Public Health and Geography present themselves as privileged forums in the sense of encouraging discussion bringing together the economic dimensions of unequal international trade with those of nature, ethics, politics, ecology and sanitation, in an effort to reorient development models (Porto, 2007). Thus, discussion of spatial economics and political ecology become important theoretical tools in understanding and coping with the new situations.

## Peripheral globalization: an alien and environmentally predatory modernization

The opening of the Brazilian economy, based on the liberal ideology suggested by the Washington Consensus and carried out throughout the 1990s, reshaped the national dependence on core nations (Brandão, 2009, 2010). For Brazil, playing a major part in the world economy meant a new spatialization of productive structures in which exports began to be concentrated in "mineral, mining and metal, steel, agricultural and agro-industrial commodities", sectors which, in turn, were characterized as being "sensitive to economies of scale and cheap energy, labor and natural resources" (Brandão, 2009, p. 157). The country entered into a cycle of economic dependence which required the export of commodities so as to maintain a positive national balance of payments. In addition to creating a new International Division of Labor, disputing markets with peripheral countries at similar levels of development, the production of commodities, such as primary aluminum, also had heavy upstream environmental impacts, creating situations of vulnerability to health and environmental injustice.

In addition to guaranteeing competitiveness in the external market through not accounting for and/or externalizing environmental damage, the current Brazilian model of development reveals a process of submission to external interests. In this verticalized development model, what Acselrad (2008) calls environmental dumping occurs, in which part of the costs of production, such as environmental damage and the social vulnerabilities which affect the sustainability of traditional populations, are neglected. The concept of environmental dumping is nurtured by the existence, in the Brazilian countryside, of a "socio-environmental war" between federal bodies, in which territories are blackmailed and disputes for investment are accompanied by flexibility of fiscal, social and environmental legislation (Acselrad, 2008).

The Brazilian model of development, carried out by hegemonic groups and sanctioned by the need to produce market share whatever the cost, is guided by the transformation of territories into markets, characterized by the advance of private ownership in processes which are damaging to the environment and avid for natural resources.

As proposed by Martinez-Alier (2007, p. 41), in industrialized or industrializing nations "there are those who say that the expansion of the economic 'cake' – that is, growing GDP – is the factor which best mitigates distributive economic conflicts between social groups". This idea is refuted by the same author, according to whom "economic growth can take place in parallel with increasing national or international inequality" (Martinez-Alier, 2007, p. 42). In peripheral nations such as Brazil, the industrialization process of the last century corroborates the idea of concomitance between economic growth and increasing social inequalities. Thus, so-called modernizing external initiatives, such as projects linked to the mining sector, transform the territories following the logic of capital and disregarding traditional models of development.

If, on the one hand, modernizing processes contribute to growth in the territories' Gross Domestic Product, on the other, such indications as this growth manifests may not be accompanied by equitable social and economic development, or may even prevent it as, in the current phase of international division of labor, "industrialization is not always capable of creating growth with development", above all "due to the lack of local coordination of activities or regressive redistribution of income" (Santos, 2008, p. 31). In this sense, increased productivity from automation, based on technological develop-

ment, gives firms autonomy from their immediate environment, enabling them to take advantage of the diversity the area has to offer (Becker, 2010), at the same time as it facilitates the use of what Acselrad (2004) calls locational blackmail, in other words, the threat of capital relocating to productive sectors in other regions or countries when pressured to provide better working and production conditions by social movements or local government.

The lack of an endogenous development process operates by impeding solidarity and community citizenship from materializing and also in the sense of "conducting integrated and permanent qualitative change and improving the well-being of the population of a location or region" (Pires, 2007, p. 160). Economic development, be it on a national, regional or local scale, should aim to achieve well--being and not be limited to providing basic material conditions. In this sense, human beings should be the beneficiaries, as well as the judges, of progress and not just the primary means of production, with peoples' lives being the ultimate aim of production and of prosperity (Sen, 1993, 2000).

## Ecological economics and social metabolism

According to orthodox economic views, environmental impacts are seen as external factors or flaws in the system and, therefore, correctable through the logic of the market with the use of adequate methods. In other words, flaws, in the case of impacts, can be adjusted through internalization in the pricing system promoted by the market itself (Cavalcanti, 2010). In traditional economics, the environment is viewed as an appendage or an object to be commercialized, as in the recent creation of carbon markets; expansion of the economic system knows no limits; there are no contingencies for trade or growth, be that due to the need for more resources or waste dumps, with environmental problems seen as flaws in the market to be corrected by the market itself, as mechanisms of internalization.

In contrast to the orthodox economic vision, ecological economics views economic activities as an open system within an ecosystem, with the latter being the whole and the economy one of its parts. In the paradigm, energy and materials enter the economic system and finally leave it as waste or degraded matter and energy. The system is seen as a living organism, assimilating resources from the environment and, after metabolizing them, returning them in the form of dirt, in what can be seen as a biophysical view of the economic process (Georgescu-Roegen, 1971).

The ecological economics paradigm originated in the seminal clash between economists and ecologists in the search for an alternative reference to the needs imposed by the search for sustainability when faced with the limitations of neo-classical economics (Porto, 2007). Forerunners to ecological economics can be found in the work of Georgescu--Roegen (1971).This author was a pioneer in bringing together economic processes with the ways in which natural resources and their respective flows between regions and countries are distributed. Along the same lines, theorists such as Frank (1967, 1978) and Wallerstein (1974) also highlight unequal trade between nations as being the mainstay of imperialism. The challenge for ecological economics lies in the extremely unequal and unjust character of the so-called global free market, in which the Southern countries specialize in exporting primary products while those in the North export industrialized products. The logic expressed by those who defend liberalism conceals the fact that the primary products sold are still intact and are exchanged for already expended products (Hornborg, 1998) or, to put it better, products generically known as commodities, possessing potential energy and material, are transferred from Southern countries to those in the North. This unequal exchange can be better understood by analyzing the flows of energy and material in the direction of core countries. In the opposite direction is a "transfer of external effects from developed countries to less developed societies" (Altvater, 1995, p. 150). The external effects are highly toxic for the ecosystems of underdeveloped nations and, although monetary compensation is made, it is never enough to cover the damage caused by the externalities of the developing process of rich nations (Altvater, 1995).

Working with the ideas of thermodynamics of Georgescu-Roegen, Altvater (1995) calls energy

reserves, such as petroleum and coal, as well as other minerals, islands of syntropy. Exploiting these perfectly ordered (islands of syntropy) reserves potentially causes processes of disorder (entropy). The order of the elements in a mineral deposit is eliminated in the process of exploitation. The minerals are, in most cases, transferred to far off regions, where production mechanisms depend on the supply of these materials. The disorder may be indirect, as in the example of reduced biodiversity in areas that have been mined, but it can also be direct, as in increased levels of toxins in the human environment (Altvater, 1995). Order, as understood in the wealth production paradigm, is only possible through the production of chaotic relationships, in other words: global society is living with a contradiction, in which both Fordist modernization and development and underdevelopment occur (Frank, 1992), likewise, in the words of Boaventura de Sousa Santos, "modern humanity is inconceivable without modern sub-humanity" (Sousa Santos, 2007, p. 76).

Maximization of the exploitation of natural resources tends to intensify when the trade terms worsen for the extracting economy. In these economies, the basis of their income, used to pay foreign debt and finance much needed imports, lies in extracting minerals. In countries which export these resources, there is a tendency for the increase in tons exported to grow faster than their economic value (Martinez-Alier, 2007). Currently, extraordinary amounts of energy and, increasingly, iron, aluminum and copper travel thousands of kilometers from South to North (Martinez-Alier, 2007). Part of this flow, as in the case of those related to minerals, leaves a trail behind characterized by the degradation of natural forests and contaminated soil and water (Martinez-Alier, 2007; Martinez-Alier and O'Connor, 1996). In a scenario of deregulation and capitalist expansion in the Southern nations, the appropriation of relative surplus value cannot be reduced to the Fordist production model, thus requiring a complement, via the production of commodities, based on the "Expropriation of the economic substance of others, accumulation by expropriation" (Altvater, 2010, p. 108). This model of accumulation, by incorporating new forms of accumulation, makes use of predatory practices, violence in extracting resources, consubstantiated in environmental damage, taking advantage of inter-regional inequalities to loot the resources of more fragile nations (Harvey, 2005; Breilh, 2008).

The territorial dynamic, in most cases imposed discretionally and according to external interests, produces environmental externalities which create situations of vulnerability, placing local populations at risk. Environmental risks should be seen as by-products of so-called development or, according to Santos and Silveira (2001), of the incompleteness of modernization, peculiar to sub-developed industrialized nations, such as Brazil.

## Current situation of aluminum production in Brazil

In recent decades, Brazil has increased domestic production of primary aluminum, leaving behind its historical role of bauxite exporter. The current importance of aluminum to the Brazilian economy can best be understood and measured by its share of GDP. In 2008, the industry around this metal represented no less than 4.5% of gross national product. In the same year, aluminum represented 3% of national exports (DNPM, 2009). Of the 1,534.9 thousand tons of primary aluminum produced in Brazil, in 2009, 1,008.3 thousand tons were consumed by the domestic market (ABAL, 2010). The importance of exporting this metal can be better understood by its share in the surpluses achieved by Brazil in the external market: in 2009, despite the international crisis affecting core countries, trade involving aluminum remained positive for Brazil, at U$2,560 million, or, no less than 10% of total trade, calculated at U$25,536 million.

The importance of aluminum to Brazil's positive balance of trade signals a structural transformation in the aluminum industry. If Brazil was, until recently, a large bauxite exporter, this condition has undergone a change and, currently, it is primary aluminum which has taken on the position in commodities which was, just a short time ago, occupied by this mineral. In addition to the scarcity of mineral resources in the core countries, another contributing factor to this change was the emigration of highly polluting industries with great environmental impact to underdeveloped nations

like Brazil. The migration of these companies is corroborated by Freitas et al. (2003), according to whom social pressure for environmental quality is lower in underdeveloped nations and, in the majority of cases, the establishment of businesses affecting the environment is viewed positively as representing economic growth and creating employment (Freitas et al., 2003).

## Socio-environmental issues and producing environmental justice

The aluminum production chain has serious environmental impacts. These are widespread and occur at all stages of the production process.

In the initial stage of production, extracting bauxite, the main impacts are related to extracting, transporting and processing. The environmental problems include particulate matter, erosion and leaching of mined areas and contamination and silting up of water resources.

In order to exploit bauxite, the surface vegetation needs to be cleared using tractors. Next, the top layer of fertile soil is removed and set apart, to be used in the recovery process. In the Brazilian Amazon, bauxite is extracted from areas of preserved forest, where there is a symbiosis between the local inhabitants and the preserved environment. In this region, mining has left a trail of environmental impacts, poverty and underdevelopment behind it (Bunker, 1985).

The aluminum industry is electricity-intensive. Thus, large global aluminum producers are, by necessity, significant electricity producers. Souza and Jacobi (2007) argue that there is a relationship between countries possessing large hydro-electric plants and the main producers of primary aluminum. The aluminum industry profile of voracious energy consumption can best be demonstrated by linking it to the energy produced by the National Integrated System – SIN (ONS, 2012). Of the electricity generated in Brazil in 2009, 445,662.85Gwh, around 5.8% of this total was consumed by aluminum producers. To compare, it is worth noting that this volume corresponds to almost half of the total electricity produced in the Northeast (47.6%) and to 62.50% of the energy generated in the North.

The environmentally unsustainable character of large hydro-electric plants can be constructed based on parameters identifying physical-chemical-biological problems originating in the establishment of businesses and the operation hydro-electric plants and their interaction with the environmental characteristics of their location (Bermann, 2007). Hydro-electric plants still function as "formidable cogs in the accumulation of capital and the mobilization of work forces." (Sevá Filho, 2008, p. 46). There is a dominant ideology which drives the country towards using barrages as the only available or viable option, concealing the true interests or motives for hydro-electric projects, as in the case of Tucuruí, which was constructed to "smelt aluminum and process ores, with Eletronorte's detrimental contracts with energy consuming industries bankrolled by the Brazilian consumer" (Sevá Filho, 2008, p. 48).

Many hydro-electric developments are marked by environmental impacts which are often transformed into conflicts with big business, or the State itself, on one side and, on the other, self-organized social groups. An analysis in the Brazilian Network for Environmental Justice (RBJA)[1] shows, for the whole of Brazil, 194 documents concerning conflicts involving the construction of hydro-electrics barrages. The conflicts are varied and largely involve socially vulnerable groups. Conflicts involving the construction of hydro-electric plants and rural communities and small-scale producers occur time and again in states such as Minas Gerais, with important hydro-electric potential (Silva and Silva, 2011; Penido, 2008; Zhouri and Oliveira, 2007; Zhouri and Gomes, 2007; Zhouri and Zucarelli, 2010; Pinto and Pereira, 2005; Sevá Filho and Pinheiro, 2006), and in other regions of Brazil (Alves, 2010; Bermann, 2007; Junk and Nunes de Mello, 1990).

The combination of inputs during alumina and aluminum production is characterized by emission of gases with high environmental and health impacts, such as perfluorocarbons (PFCs). Some recently produced inventories in several Brazilian states show the aluminum industry's share in gre-

1 Available: <http://www.justicaambiental.org.br/_justicaambiental/>. Acessed: 10 Mar. 2012.

enhouse gas emission: in Minas Gerais, in 2005, the aluminum industry share of greenhouse gas emissions was 13% of the total, behind only the cement (43.9%) and lime (38.2%) industries (FEAM, 2010); In São Paulo, in an inventory of fixed $CO_2$ sources, drawn up by the CETES in 2008, non-metal mineral industries (including, in addition to primary aluminum production, lime kilns, cement and glass production), occupied second place in $CO_2$ emissions, contributing 26.4% to the state total. In the ranking of companies emitting the most $CO_2$ in 2008, the Cia. Brasileira de Alumínio, now known as Votorantim Metais, was in sixth place; inventories in other states have also indicated the primary aluminum industry as a potential source of $CO_2$: in Bahia, the primary aluminum industry emitted 6.5% of total $CO_2$, placing it in sixth, behind the Magnesium (24.7%), Cement (20.6%), Iron and Steel (15.9%) and Iron alloy (13.7%) industries (SEMA, 2012); In the state of Rio de Janeiro, the aluminum industry occupies fifth place in the ranking of total volume of greenhouse gas emitted in 2005, and first place of industries producing methane and nitrous oxide (SEA, 2007). The increase in emission of gases in peripheral countries such as Brazil seems to be linked with reductions in core countries. Decreased emissions in the United States has been deemed to be the result of companies moving abroad (Koehler and Spengler, 2007).

## Discussion

Brazilian aluminum production has been ascendant which, in turn, has placed added pressure on other sectors, such as electrical energy. As mentioned above, producing hydro-electricity comes up against significant socio-environmental issues which are ignored and externalized. Externalities are produced in the construction of hydro-electric projects aiming to guarantee low cost energy for production and, in no small part, exportation of competitively priced aluminum. Thus, "in the name of an industrialist concept of progress, material conditions of socio-cultural groups' existence in the territories concerned are destroyed" (Acselrad et al., 2009, p. 122-123). The goal of the development paradigm typical to these projects is economic growth in contrast to the notion of development which, according to Sachs (2008, p. 13-14) should mean "expiation and reparation of past inequalities" the greatest objective of which would be "to promote equality and maximize advantage for those living in the worst condition." According to Porto and Milanez (2009), the current concept of development, arising from intensification in the globalization process, is the product of "productivist and consumerist criteria that disregard human life and ecosystems, as well as the culture and values of the populations in the territories where investments and chains of production are established" (p. 31). In the model of development, postulated by Harvey (2005), of accumulation by expropriation, the characteristics are expulsion of the peasant population, increases in landless proletariat, privatization of formerly shared resources (often under the auspices of the World Bank), to the detriment of autochthonous or alternative forms of production.

Brazil's transformation into a significant primary aluminum exporter can also be understood as a result of what Harvey (2005) calls the technological revolution in production, in which the core of social domination lies in structural processes of a new model of accumulation, christened "looting" by the author. Now, the current logic of capitalism makes use not only of traditional mechanisms of accumulation, but also "predatory practice, fraud and violent extraction, applied to taking advantage of inter-regional asymmetries and inequalities to loot resources directly from more fragile countries" (Breilh, 2008, p. 162), as is the case of Brazil and, especially, of poorer regions where mining companies are established. Even though the firm provides financial compensation so as to mitigate this, it is never enough to cover the damage caused by externalization, since, as suggested by Altvater (1995, p. 150), "if full compensation for damage were required, the transfer would never be made".

The Brazilian commodities export model, nourished by products such as aluminum, conceals the undervaluation of the labor and health of the poor, which explains the deterioration of the unequal exchange specified in the prices (Martinez-Alier, 2007). In agreement with the ideas of Martinez-Alier (2007), the idea of unequal trade should be reshaped to include disregarded local environmental externa-

lities. Martinez-Alier (2007, p. 289) see the exportation of products originating in poor countries or regions and which do not account for the externalities included in their production processes, or for the using up of natural resources, as "unequal ecological trade" and "ecological dumping". This is the form of the current international trade scenario, generating flows of energy, material and distribution of wealth synthesized in a social metabolism which intensifies social inequalities and environmental damage (Porto, 2007; Porto and Martinez-Alier, 2007; Porto and Milanez, 2009). Thus, "when a rich country imports cheap primary material in the commodities market, they are also importing natural resources, such as water and soil, from distant regions and territories where social and environmental damage is occurring" (Porto, 2007, p. 61).

Finally, as underlined by Franco (2010), the current economic model translated by globalization processes, has led to the reappearance of greater social exclusion than ever and to a socio-economic rift between Northern and Southern countries, rich and poor, and in the crystallization of local and global environmental problems.

## Final considerations

In this article, we sought to present a theoretical discussion between issues concerning territories involved in the aluminum production chain and political ecology. The aim was to demonstrate that the theoretical political ecology framework is an important tool in supporting better understanding of the production of new territorialities. Likewise, we intended to demonstrate just how damaging the production of new territoriality, linked to the production of commodities destined for export, has been to the populations inhabiting these territories. What can be seen as an apparent advance, in this case, the exportation of primary aluminum instead of bauxite, conceals issues involving diverse socio-environmental damage. Bauxite extraction, or the electricity-intensive character of production, conceal the conflicts which often occur with small producers, *quilombolas* and communities living in the forest who, on various occasions, have seen their territories flooded in order to generate electricity.

Based on the data discussed throughout this text, it can be understood that Brazil has increased its share in the international market, meeting the needs of developed nations. Thus, while Brazil remains a peripheral nation, it is inevitable that, in order to increase GDP growth rates, there will be collateral damage leading to situations characterized by local and global socio-environmental tragedies (Porto and Milanez, 2009).

The political ecological paradigm enables the understanding of economic flows privileging core compared with peripheral nations in a perverse logic in which territories are shaped according to external interests. In nations such as Brazil, this paradigm should be linked to others, based on sustainability for the environment and the traditional populations, reshaping the idea of development so as to go beyond GDP growth.

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