

FROM IQUITOS/PERU TO PARINTINS/BRAZIL: URBAN NETWORK AND RECYCLING IN THE AMAZON

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ABSTRACT:

The Amazon Basin is in a constant urbanization process. Even in isolated areas, domestic waste is a problem. How does the recycling market function? How are the working conditions of the waste pickers? Can the urban network be understood through the recycling market? These questions oriented field work from Iquitos, Peru to Parintins, Brazil (2011-2014) which evaluated recycling. Due to the almost nonexistence literature a detailed description of the study case is made. As result, the market structure was divided into three different nodules: Lima (Peru), Bogotá (Colombia) and São Paulo (Brazil). Each nodule has different approaches of what is recycled and how. It was observed an intense informal market for recycling with no workers-rights and low incorporation of technology with restricted materials recycled, mainly aluminum. What and how innovations in recycling technology and market structure can be introduced in the area that can transform reality is a central question.

DE IQUITOS/PERU A PARINTINS/BRASIL: REDE URBANA E RECICLAGEM NA AMAZÔNIA.

RESUMO:

A Bacia Amazônica está em um processo de urbanização constante. Mesmo em áreas isoladas os resíduos domésticos são um problema. Como são tratados os resíduos sólidos? Como funciona o mercado da reciclagem? Como são as condições de trabalho dos catadores de lixo? Pode a rede urbana ser entendida pelo mercado de reciclagem? Estas questões orientaram um extenso trabalho de campo entre Iquitos, Peru e Parintins, Brasil (2011-2014). Devido à literatura quase inexistente uma descrição detalhada foi realizada. Como resultado, a estrutura do mercado foi dividida em três nódulos: Lima (Peru), (Colômbia) e São Paulo (Brasil). Cada nódulo tem diferentes abordagens do que é reciclado e como. Observou-se uma intensa rede informal no mercado local para reciclagem sem-direitos dos trabalhadores - catadores, baixa incorporação de tecnologia e com materiais reciclados restritos principalmente alumínio. O que e como as inovações em tecnologia de reciclagem e de mercado podem ser introduzidas na área, visando transformar a realidade é uma questão.

PALAVRAS-CHAVE:

Reciclagem, resíduos sólidos, estrutura de mercado, catadores, Rio Amazonas.

DE IQUITOS / PEROU À PARINTINS / BRÉSIL: RÉSEAU URBAIN ET LE RECYCLAGE DANS L'AMAZONIE.

PALABRAS CLAVE:
le recyclage, les déchets
solides, la structure du
marché, les collecteurs
de déchets, fleuve
Amazonie.

RESUMEN:
Le bassin de l'Amazonie est dans un processus d'urbanisation constante. Même dans les zones isolées ordures ménagères est un problème. Comment le marché du recyclage fonctionne? Comment sont les conditions de travail des ramasseurs de déchets? Le réseau urbain peut être comprise à travers du marché du recyclage? Ces questions orientées travail sur le terrain à partir de Iquitos, Pérou à Parintins, Brésil (2011-2014) qui a évalué le recyclage. En raison de la littérature presque inexistence d'une description détaillée de l'étude de cas est fait. Comme conséquence, la structure du marché a été divisé en trois nodules différents: Lima (Pérou), Bogota (Colombie) et São Paulo (Brésil). Chaque nodule a des approches différentes de ce qui est recyclé et comment. Il a été observé un marché informel intense pour le recyclage des travailleurs sans-droits et à faible incorporation de la technologie avec des matériaux recyclés restreintes, principalement l'aluminium. Comment les innovations dans les technologies de recyclage et du marché peuvent être introduits qui peut transformer la réalité est une question centrale.

INTRODUCTION

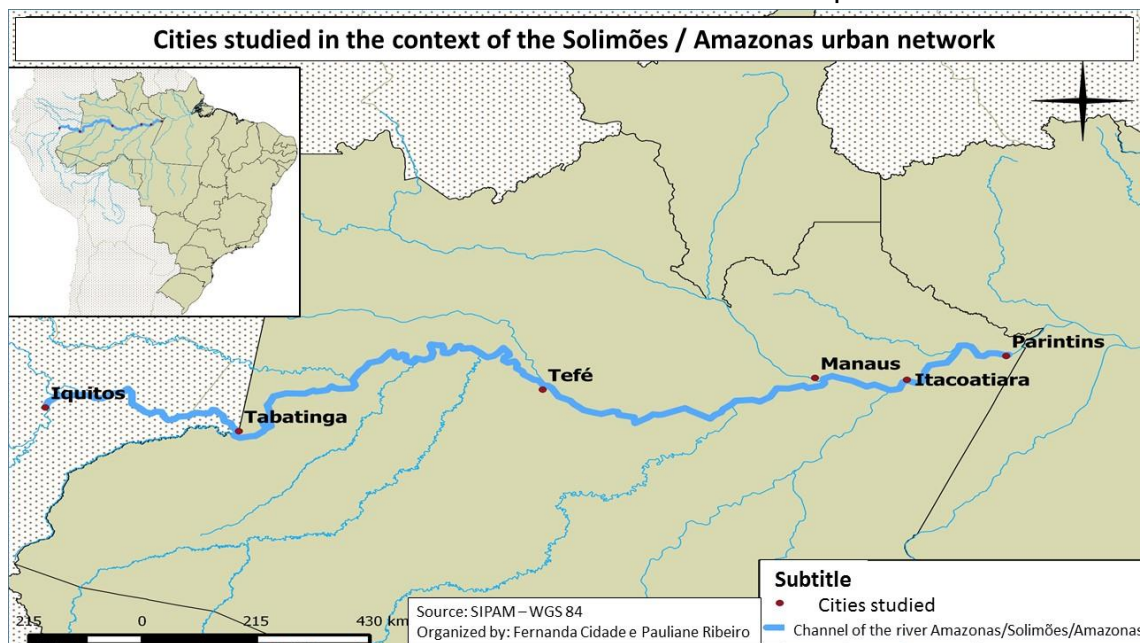
Recycling is a known word and has gained significance in a world embedded in the discourse of sustainable development. Garbage, rubbish, trash, litter, unwanted use-value for society in general, has become exchange-value for many people who recycle as their only means of survival (GODOY, 2009). One of the main points in the sustainable discourse is that the recycling of certain materials is a *sine qua non* condition for the reduction of natural resources consumption and minimizes human impact on the environment. The recycling of solid waste stands out in the discourse of transformation towards a more sustainable world.

The study of solid domestic waste that covers both the origin and the destination of these materials also implies the need to understand the human context that is part of this value chain, especially those recycling workers who are the fragile link in the recyclable market. Working conditions in this value chain is an important aspect that should be high-lighted. It is also important to understand each step of the process that makes the recyclable domestic waste into a commodity, a process that begins in the collection and separation of these materials so they can be sold to industries that reuse them in the manufacture of new products. What are the different forms of social organization and incorporation of innovative social technology that can be found in the “factory floor” of this recycling world-wide networking market? How can specific cases help understand the world-wide dynamics? How can this market help elucidate the urban network along the Amazonas river? This paper presents a specific case – the recycling network along the Amazon river, from Iquitos/ Peru, through Leticia/Colombia to Parintins/Brazil. A transboundary Pan-Amazonian market

embedded in the globalization process this paper aims to identify and understand how this market structures the urban network in the Pan-Amazon region, particularly in the Brazilian and Peruvian Amazon.

With the funding of Amazonas State Research Support Foundation (FAPEAM), CNPq and the Institut de Recherche pour le Développement (IRD) the research that fomented this paper was developed from Iquitos in Peru to Parintins in Brazil over the years 2011-2014, with study sites in addition to the mentioned cities, in the Brazilian towns of Tabatinga, Tefe, Manaus and Itacoatiara, State of Amazonas - Brazil (Figure 1). These cities are located along the mainstream of the Amazon river and were chosen for their importance in the existing urban network in the region (SCHOR et al, 2014).

Figure 1: Cities studied in the context of the urban network along the Amazon and Solimões River. Source: SIPAM – WGS 84



Organized: Fernanda Cidade and Pauliane Ribeiro, 2015.

Methodological procedures adopted were the same in all six cities. Visits to the local open air landfills were made and families working in them were interviewed and the working process was analyzed and discussed. Waste pickers found working in the city's streets were contacted and functioned as an entrance to the local recycling network. Through them the main recycling businessman were identified and their working place visited. Local authorities were contacted and interviewed. The objective of the visits and interviews was to identify the market structure (how, to whom and when the recycling material was sold) building a comprehension of the recycling network in the region. Working conditions were also a focus of analysis, specially related to child labor in the open landfills. The cities of Tabatinga, Tefe, Manacapuru and Parintins were visited twice while the others only one visit was made.

In order to best understand the data collected detailed field notes where taken. These fieldwork notes where then compared with secondary data for the region and for

Brazil. This procedure permitted a regional and national scope of analysis. Due to the almost inexistence literature on this theme in the Amazon this paper is organized in a descriptive format. The lack of systematic secondary data makes spatial and temporal comparison very difficult.

Urbanization in the Amazon

The Brazilian cities chosen for analysis, with exception of Manaus, are considered as medium sized cities in the Amazonian context (SCHOR *et Al.* 2014). Manaus as the capital of Amazonas state has a population estimate of approximately two million inhabitants of which almost 100% is living in the city. In all the cities analyzed, there has been a constant population growth with a significant urban population exceeding 60% in all cases.

Table 1: Population distribution in the municipalities analyzed.

POPULATION				
MUNICIPALITY	ESTIMATE 2014	TOTAL 2010	URBAN 2010 (%)	RURAL 2010
PARINTINS	110.411	102.033	69.890 (68,49%)	32.143
ITACOATIARA	95.714	86.839	58.157 (66,97%)	28.682
MANACAPURU	92.996	85.141	60.174 (70,67%)	24.967
TEFÉ	62.662	61.453	50.069 (81,48%)	11.384
TABATINGA	59.684	52.272	36.355 (69,55%)	15.917
MANAUS	2.020.301	1.802.014	1.792.881 (99,49%)	9.133

Source: IBGE, 2015.

Accompanying the population growth, these cities have seen an important impact in their municipal Human Development Index:

Table 2: Municipal Human Development Index, 1991-2000-2010

HUMAN DEVELOPMENT INDEX			
MUNICIPALITY	1991	2000	2010
PARINTINS	0,414	0,488	0,658
ITACOATIARA	0,408	0,491	0,644
MANACAPURU	0,339	0,437	0,614
TEFÉ	0,349	0,438	0,639
TABATINGA	0,333	0,470	0,616
MANAUS	0,521	0,601	0,737

Source: PNUD-Brasil, 2015

Urbanization and economic growth in the Amazon brought changes in the habits of the local population, resulting in the increase of solid domestic waste in cities and communities, but this increase was not accompanied by an adequate management of waste considering geographical-local conditions. Open air deposits of solid waste are large open landfill dumps that have environmental impact directly affecting the fauna and flora, human health (as most of them are near the cities and water courses) as well as being the main place of work of waste pickers in the Amazonian cities (CIDADE, 2013).

The commercial network of the recyclable materials in the cities studied is mainly through the manual collection, separation and distribution. Social technology is almost nonexistent. Mostly waste pickers that scavenge these open-air landfills and dustbins in the city selling their collected material to recycling material stores called *sucatarias* do the collection and separation. These *sucatarias* are an important nodule in this network and are present in all the cities analyzed. They are mainly small shops that buy from the pickers, do some simple process of concentrating, diminishing the volume, sell, and distribute these products to the recycling industries, thus forming the reverse supply chain of post-consumer whose manual collectors are the basis of this chain (AQUINO, JR.; CASTILHO PIRES, 2009).

In Brazil, through the National Policy of Solid Waste, there is a legal incentive to formalize this chain through the regulation of the activity of the waste pickers or manual collectors with associations and / or cooperatives. In this sense it can be observed some sort class organization, mainly imposed by the National Policy. This class organization, when they function, helps control the network especially in relation to working conditions and prices. Not much can be done in a context of monopsony, in locations where there is only one buying store.

In the Peruvian Amazon, especially in the city of Iquitos, with a population of approximately 430.000 (PNUD, 2015), there inexists an organization of waste pickers and these are employees of sucatarias locally called *chatarras*. Iquitos outsources virtually all of recyclable materials mainly to Lima, capital of the country.

There has been a long tradition in the Brazilian literature about the nature of these class organizations, the informal work process, impacts on health and exclusion of these waste pickers (PORTO, ET AL. 2004; VELLOSO, 2005; SIQUEIRA; MORAES, 2009), but very little has been written about the recycling network along the Amazon river from Peru to Brazil. As discussed the Amazon Basin has become more and more urbanized (BECKER, 2000; SCHOR, 2013). With the growth of cities and the consequent transformation of habits there has been an increase in the production of domestic solid waste. Even in isolated areas such as along the Amazon River in Peru, Colombia and Brazil, domestic waste is a growing problem. How is solid waste treated? What are the opportunities of recycling? How is the recycling market functioning? What are the potentials in terms of market and technological innovation for the recycling and disposing of solid waste in the Amazon? These questions will be answered along this paper by means of a careful description of how this network functions along the Amazon River.

Manaus industrial pole and the non-existent reverse industry

The Manaus Free Zone constitutes a tax exemption area created by Decree-Law No 288 of 28 February 1967, in the geographical center of the Amazon. Initially, its area was restricted to the city of Manaus, continually being expanded throughout Western Amazon, comprising the states of Amazonas, Rondônia, Roraima and Acre and corresponding to approximately 25% of Brazil, covering the region denominated as Legal Amazon. Although its deployment occurs in 1968, its creation is based on Law No. 3,173, of June 6, 1957. The law established as a main objective the creation of a specific area of free trade designed to meet domestic consumption in the Amazon or export to neighboring countries (OLIVEIRA; SCHOR, 2008).

Prior to 1967, the impact on urban spatiality was negligible, but from that date on free trade and the Industrial District based especially on the assembly components of electrical and electronic industry were installed. Since 1976, the Superintendence of the Manaus Free Trade Zone (SUFRAMA), Federal Government Agency responsible for the administration and planning of the Free Zone, established nationalization indexes that focused in protecting local industry avoiding temporary investments and the installation of simple assembling industries.

The Industrial District reached its peak in 1989 with 425 companies located in Manaus. In the same year, labor employed in the industrial sector accounted for 127,804 direct jobs in Manaus, with 74.818 in the Industrial District area. The total of direct jobs in the industrial sector in the area of the Superintendence of the Manaus Free Zone was 137,113 (SUFRAMA, 1989).

In 1990, stressed by the Brazilian economy crisis, which has been dragging on since 1983 due to the wage squeeze and an opening to foreign markets, the Manaus Free Zone diminished its force. These factors made explicit that the development model

proposed by the Manaus Free Trade Zone is feasible only in highly favorable terms, that is, public investment, tax exemption and heated economy.

The economic crisis led to the idleness of the companies in the Industrial District, reaching 80% on average in late 1991, with a total suspension of some sectors. The crisis continued to worsen, and the first quarter of 1992 reached 40% of the plastic material sector, 80% of electro - electronics industry and communications and 50% of the watch industry. In March of that year, unemployment in Manaus reached 78.17% in the industrial sector. Two months later, the level of direct jobs in the industrial sector was 20,000, a decrease when compared to December 1989 of 84.56%.

During the 2000s, the Manaus Industrial Pole - PIM is established as a strong exporter leaving aside the commercial advantages that the Free Trade Zone once had. This shifts had an impact on domestic tourism to the region, which had a strong commercial basis. The level of employment in services, especially in commercial homes, decreased drastically. With competitive products in the global market, PIM started to export mainly mobile-communications equipment, with the flagship on mobile phones, and motorized two wheels motorcycles.

Today Brazil is a world reference in recycling, and world record holder in the processing of aluminum cans. There are high levels in the recycling of glass and cardboard, even without legal obligation (ABAL, 2012), but very few recycling companies or industries have established themselves in Manaus Industrial Pole. In 2015, we encountered five companies that are in the recycling post-consumer chain:

Table 3: Recycling Companies in Manaus, 2015.

Nº	Companies	Materials
1	Resídue	Glass
2	Indústria de papel Sovel da Amazônia LTDA	Paper and Cardboard
3	Coplast Indústria e comercio de resíduos Plásticos LTDA	Plastics
4	Rio Limpo	Paper, Cardboard, Plastic and Tires
5	PCE Embalagens	Paper and Cardboard

Source: Compromisso Empresarial para Reciclagem (CEMPRE), 2015

After 21 years of the National Congress approved the Law No. 12.305 / 2010 - National Policy of Solid Waste that among its other decrees, consolidate the recycling

process in Brazil, providing legal support and encouragement to this growing activity in the country. With the implementation of this law, the country can finally solidify the issue of management of goods and materials after the end of life cycle, called post-consumer products through reverse logistics.

Within these actions is included the implementation of selective collection in Brazil, preferably with the participation of cooperatives and other forms of reusable and recyclable material collectors formed by individuals of low income groups. In determining a shared solid waste management between the different spheres of government, the business sector and other segments of society participate in the process. Thus the law formalizes and provides legal support to existing network of Recyclable Materials Commercialization in Brazil, with the manual collectors; the scrap and recycling industries the main members of this productive chain of post-consumer (AQUINO, JR.; CASTILHO PIRES, 2009).

In order to understand how the Amazon, especially the state of Amazonas, is inserted in this reverse supply chain of post-consumer, creating their own commercial network and how it ties in with other regions of Brazil it is necessary to first understand how the manual collectors of recyclable materials (waste pickers), main agents of this production chain, fit into this "sustainable" market. Therefore the research identified the commercial network of recyclable material and within the waste pickers identified their weaknesses and challenges to consolidate recycling as an essential activity for the development of urban space.

The reverse supply chain of Amazonas post-consumer market

The Center for Research and Study of Cities of the Brazilian Amazon (Nepecab) developed in 2006 the Urban Network Program in Solimões River - Amazonas in order to characterize the Amazonian urban network. This program resulted in a new classification of Amazonian city-types according to their importance in the urban dynamics of the region (OLIVEIRA; SCHOR, 2011; SCHOR, 2013; SCHOR ET AL. 2014). In this classification, the cities of Tabatinga and Tefé are characterized as "medium-sized cities of territorial responsibility". Itacoatiara and Manacapuru as "medium-sized cities with intermediate functions", while Parintins remains with uncertain classification.

In 2011, interested in analyzing how the recycling commercial network functioned in these cities the variable solid waste, specifically the commercialization of recyclable materials, was chosen to characterize the urban dynamics in the cities of Tabatinga, Tefé, Manacapuru, Itacoatiara and Parintins. In this research, we found that the cities have their own dynamic structure that supports the reverse supply chain after consumption. This result helped classify Parintins as a "city of territorial responsibility" (CIDADE, 2013), consolidating the urban network typology.

In the Amazon, especially in the cities studied, the actors that structure the chain of reverse post-consumer scrap collection are the *sucatarías* owners (small entrepreneurs) and recyclable material collectors. The *sucatarías* are shops where the commercialization of recyclable metallic materials (iron, steel, copper, aluminum, zinc, magnesium, etc.) is done. As some industries specializing in the recycling of non-

metallic recyclable materials (paper, glass, plastic, cardboard, tires, etc.) opened in Brazil few of these *sucatarias* also commercialize these products. In the cities where the research was conducted, the *sucatarias* function as middlemen for these materials, particularly metallic material bought directly from the metal-scrap collectors and sold the material with almost no transformation to larger *sucatarias*.

Figure 2: Aluminum cans transformed into cubes, Parintins.



Source: CIDADE, Fernanda. Oct. 2010

In Tefé and Parintins there is also the strong presence of middlemen or intermediaries that stand out in the trade between rural communities and the city. As the middlemen are the only buyers of recyclable materials in the region they are not merely intermediaries who buy scrap from neighboring municipalities and sell to Tefé and Parintins but form a monopsony, controlling prices and working processes. Thus, the extension of co-relation based on exploitation is created, since the collector only has the intermediary as purchaser of the material collected while the middleman has at its disposal a group of collectors willing to sell their materials. So for *sucatarias* it is more profitable and practical to buy from a middleman that makes long journeys by boat collecting the material in the hinterlands transforming the network in a very well knitted tissue.

In the city of Tabatinga, located in the region of Alto Solimões (High Solimões) tri-border Brazil-Colombia and Peru, distances in a straight line 1.108 Km and fluvial 1.573 km from the capital of Amazonas State, Manaus, and the local city-middlemen stand out due to the lack of a minimum structure in the commercial network. This fact differentiates Tabatinga from Tefé and Parintins, where middlemen trade only in between the municipal city and rural communities.

The organization of manual collectors is through cooperatives or associations, considering that in places where the recycling activity becomes an important alternative income for unskilled workers, although it is treated with contempt and suffer social exclusion. So when they are organized into cooperatives or associations, collectors seek, in addition to improving income and the professionalization of the collector's work, social inclusion and the recovery of citizenship is also a goal.

In 2012, in the cities studied, the organization of collectors was recent and with great presence of informal collectors working in municipal landfills in unsanitary conditions and extremely dependent on middlemen. The exception was Parintins by already having the Association of Collectors of Parintins Trash (Ascalpin) and able to offer its members the opportunity to collect materials without the intervention of middlemen, it has a certain ease in transport logistics, given that the vice president of the association offers a ferry to transport the materials.

In Parintins middlemen stand out in the collection step because as sucatarias buy from the hinterlands and neighboring municipalities they are not merely intermediaries. For the sucatarias is more profitable and practical to buy from a middleman that makes long journeys by boat collecting the material of the municipalities such as Amazon village, Caburí, Mocambo, Nhamundá, Barreirinha.

Figure 3: Open air-waste dumps / landfills in Tabatinga, Tefé and Parintins, 2011.



Source: CIDADE, Fernanda. 2011.

In Tabatinga, as a triple border between Peru and Colombia is virtually opened, it is very common to find Peruvians and Colombians living in the Brazilian side of the border. According to the Secretary of the Environment of Tabatinga (Semas) in 2011 were counted 56 collectors, only 4 showed Brazilian documents, all say they are Brazilian but Spanish accent is audible. The lack of national identification documents is a hindrance to creation of Collectors Association in the city, but the promise of Semas is

the immediate regularization of the situation. With the delivery of the documents and if necessary the naturalization of foreign collectors, considering that many of them live with their families near the dump invasions. According to the secretary of the Semas, the municipal project of solid waste management in terms of social issue is not addressed, despite being provided for in the new law. In further field works (2012 and 2014), no significant change was verified and the situation continues as such.

Figure 4: Working place of waste pickers in Tabatinga, Amazonas.



Source: CIDADE, Fernanda. September, 2014.

Due to Tabatinga's proximity to Leticia in Colombia and the Colombian prices of recyclable materials are more competitive, recyclable materials removed from the dump of Tabatinga by local collectors are sold to sucaterias in Leticia which has a shed next to the municipal open-air dump where the separation of recyclables are made. In Leticia, the structure of the commercialization network is much more defined than Tabatinga, starting with the place of commerce. There is a street in the city where all the sucaterias of Leticia (ten at all) are located functioning hierarchically. There is in Leticia a “maiorista”, name given to the owner of the largest sucateria in the street, being the sole buyer of the other small scrap dealers. This scrap dealer trades directly with Bogotá, sending an average of 35 to 40 tons of recyclable material by plane per month. While the small scrap dealers buy the kilo cans for \$ 1000 Colombian pesos the “maiorista” buys at \$ 1200 pesos.

Therefore, many occasional Tabatinga waste pickers with significant amounts of recyclable material prefer to sell their materials to this “maiorista” because it offers a more valued price. Thus inserting Tabatinga in the international trade of recyclable material.

The city of Tefé, located in the region of Middle Solimões, distances 523 km in a straight line and 631km by boat from Manaus, has a strong influence from hydrological system. The river impacts local production specially in the floodplains. With the intention to complement the family income some farmers who live near the city, especially women, go to the municipal dump to collect recyclable materials to be sold at the city sucaterias when the waters are too high flooding agricultural areas or too low

drying extremely agricultural areas. The women and their young children spend the whole day in the open-air waste dump collecting aluminum cans, which will then be sold in one of the three local sucatarias.

Tefé's has four sucatarias working with non-ferrous materials. These sucatarias buy mainly aluminum cans from the local collectors and also from collectors located in the cities of Uarini and Alvarães. In this sense, Tefé functions as a regional nodule in the recycling material network. One the biggest sucataria has a compressing machine that produces blocks of compressed aluminum cans, this was the only process observed in these cities, most materials are sent "raw" to Manaus or Leticia (CO). All recycled material is sent by boat to Manaus and then to São Paulo, southeastern part of Brazil.

In Tefé the collectors are still working at the dump with no restrictions or protection. The municipal waste is located on the road INCRA (National Institute for Colonization and Agrarian Reform) which facilitates that some of the collectors are the residents of the agrarian settlements located along the road.

In 2013, Tefé municipal administration managed to organize their informal collectors into a Cooperative Collectors of North Recyclable Materials (COOPEMRN) being a central headquarters in the city of Maraã, distant 194 km Tefé straight, or 12 hours by local boats. This organization had a very short life span; the following year the cooperative's activities were stopped because they could not sell the products collected by lack of transport and had no room to store more materials.

In Manacapuru, in the lower Solimões region, connected to Manaus by road, distancing less than 100km, the reality is not different. When analyzing the reverse supply chain of post-consumer in Manacapuru it was observed an incomplete process when compared with Manaus and even more limited when compared to Brazilian production chain. There are many factors that characterize it that way, among them are the dependence that the city has to Manaus, the absence of recycling industries in the city and the commercial chain limited to only buy and sell recyclable materials.

Thus, Manacapuru becomes a member of the reverse supply chain post-consumption of Manaus, and the fact that recyclable materials are collected and sold only in the city, Manacapuru creates its own commercial network. Compared to other cities of Amazonas state, Manacapuru, has peculiarities as to the subjects that are part of their supply chain recyclable. The presence of sucateiros is very strong in other cities in the state but in Manacapuru they have secondary function in the network.

In field, research conducted at the end of July 2014 in the city of Manacapuru it was not identified any sucataria, but small shops who performed the metal scrap business. The owners of these establishments added this activity in order to increase income; recyclables are not the main source of income.

While in other cities it is common for collectors to sell their materials to sucatarias in Manacapuru the tables are turned. They are collectors that are in a position to purchase these materials, since in most cases these small establishments has no transportation and enough space to store recyclables. Despite these peculiarities, these small sucatarias commercialize scrap, copper, metal, aluminum, tin, battery and other nonferrous metals.

As for the collectors of the city of Manacapuru these are organized into two associations, and both receive assistance of local government and were created in 2012.

The first is the Association of Collectors of Manacapuru, which has the trade name of MPU - Recycle and the other, is the Association of Waste Pickers of Manacapuru with the fancy name of COTEPLA. Members collect the materials from the municipal landfill and urban areas of the municipality.

In both associations, although they sell recyclable materials together, each collector earns in accordance to their individual production. The control is done by weight of the recyclable material collected by each collector, this value is recorded and when the association sells the recyclables per kilogram, the collector is paid. The medium gain is very variable because it depends on the production of each collector, and this in turn depends on the availability of recyclable material and collector's disposal. However, when the collector is in full work ability and has a good collection day, according to the presidents of the associations, can achieve R \$ 450.00 per day.

In Manacapuru there is an individual agent of the reverse supply chain that stands out, acting independently. He is an independent collector of recyclable material, because he works with all recyclable materials and not only scrap, and is not just a collector because it he is not connected to any association, cooperative or organization of waste pickers.

This independence has enabled him to own properties such as a shed where recyclable materials are stored, machinery to make the pressing of recyclables, a truck to transport these materials, employees responsible for collecting, sorting and pressing of materials, in addition to expanding his commercial network to neighboring cities such as Novo Airão and Iranduba. With this structure and as an independent collector he created his own commercial network of recyclable materials standing out in the reverse supply chain post-consumption of Manacapuru. In Iranduba and Novo Airão he managed to structure the commercialization of recyclables where he is the only buyer, creating a monopsony.

The municipality of Itacoatiara is linked to Manaus by road and is also part of the reverse supply chain of Manaus, however, with a limited structure, with only one sucataria and an Association of Waste Pickers (Ascalita). At the time of fieldwork (July 2011), members of Ascalita, lacked a place to store the materials and or equipment to do the pressing of aluminum cans. The site of collection and sorting of recyclables is done in own municipal open-air landfill with large bags called "big bag" in precarious conditions.

Both the sucataria and the association, due to the fact that they lack transportation, are dependent on middlemen to get the recyclables to Manaus. Each takes about two to three weeks to fill a truck with four to six tons of all solid waste collected for recycling. Arriving in Manaus these materials fall into the commercial network of the city, where the non-metal is recycled in Manaus. The other materials are commercialized to other destinations in Brazil. Some destinations are certain, for example, Minas Gerais, Rio de Janeiro and São Paulo, where the metallic materials recycling industries are located.

Figure 5: Open-air landfill and place of work of waste pickers in Itacoatiara, Amazonas.



Source: CIDADE, Fernanda. July 2011.

In all the analyzed cities it was verified a very low organization. There are very few workers organization or any other kind of commercial network organization. The middleman and the *sucatarías* dictate the market structure and have a strong power in determining prices due to their monopsony status. There has been very few initiatives of the government to change this reality. This scenario implies in a very low capacity of technology incorporation. An extreme worker exploitation, with families (and their children) working as waste pickers in towns and in the open air landfills. The Associations of Waste Pickers in Manacapuru and Itacoatiara are an exception in terms of social organization but in terms of working conditions and incorporation of technology the reality is much the same as those encountered in other cities.

Recycling in Iquitos, Peru

According to Chang (2013), solid waste management in Peru is responsibility of the local government and municipalities. A General Law on Solid Waste was established in 2000, called Law no. 27314, which classifies two distinct types of recyclable materials: domestic and non-domestic (mainly Health related). Chang considers that the information on domestic waste recycling is limited and undependable in Peru due to the informality in the network. The author inferred that only 5% of all waste produced in the cities are recycled. Most of the recycling in Peru is done in Lima, centered in the San Juan de Lurigancho neighborhood. The recycling is based on informal waste pickers and recycling houses, *chatarras*. In Lima, the

recycling is based mainly on tires, used acid-lead batteries, computers and accessories and used oils which are recovered and sold. Most of the materials are collected door-to-door by waste pickers and in the open-air landfills.

In the Peruvian Amazon, it is not much different. Iquitos, capital of Loreto and Maynas Province in Peru, known as the biggest city worldwide that cannot be reached by land routes, has the most important river port in the country and connects through the Amazon River, with other countries of the Pan-Amazon, such as Colombia and Brazil. The population of Iquitos is approximately 438 000 inhabitants, very concentrated in the urban area of the city, its main mode of transport are the rivers, but in 2005 a road linking Iquitos to Nauta was built with approximately 280 km.

In Iquitos, there is the commercialization of recyclable materials, which occurs through local sucaterias called *Chatarras*. These *Chatarras* are small sucaterias, which unlike those existing in the Brazilian Amazon sell many recyclable materials (aluminum, plastic, paper, cardboard) and act as collectors of recyclable material and send them daily to their warehouses located in peripheral areas of the city. Two sheds were visited, in which it was identified the process of separation, pressing and grinding of recyclable with the machinery available.

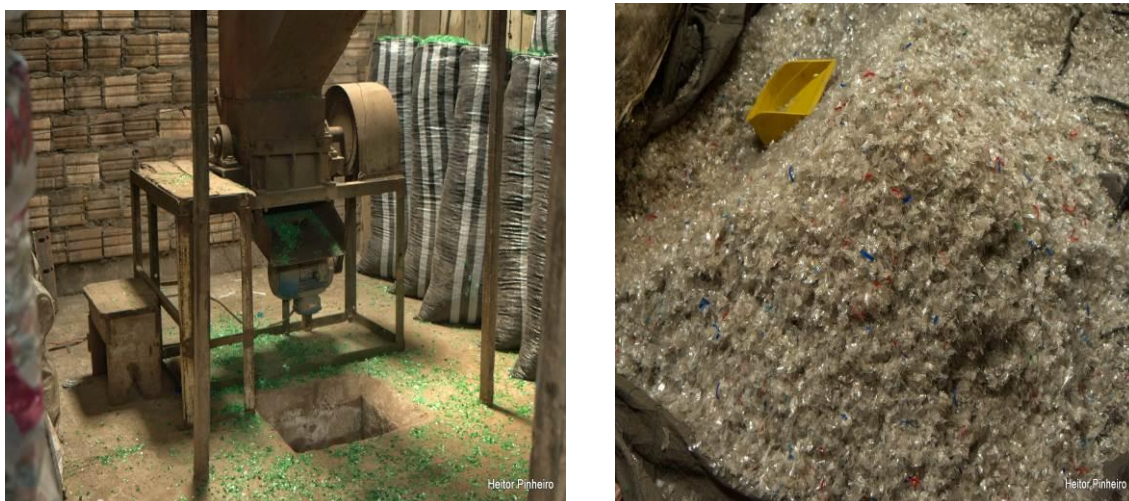
Figure 6: Chatarras in Iquitos.



Source: CIDADE, Fernanda. Set. 2014

It was noteworthy the shedding of plastic bottles, a process not encountered in the Brazilian Amazon.

Figure 7: Plastic bottle shedding machine in Iquitos and shredded plastic packed ready for transportation from Iquitos to Lima.



Source: PINHEIRO, Heitor. Set 2014.

These recyclable beneficiation processes are done by contract employees working from Monday to Saturday earning between 20 and 30 soles a day, less than US\$10,00 daily (September 2014). It is noteworthy that the working conditions of these employees are neither ideal nor appropriate, but still are not worse than the waste collectors who work and live at the open landfill of Iquitos, called botateiro for municipal solid waste, which is deposited without any discrimination. There are about 100 families living in the open-air landfill that depend on Iquitos chatarras to market the collected recyclable. The city of Lima is the destination of recyclable materials collected from Iquitos, where they are sent 10-20 tons fortnightly.

Figure 8: Lixão or Botateiro in Iquitos, Peru – set 2014.



Source: CIDADE, Fernanda. Set. 2014

There has been an initiative of the Save the Rainforest for recycling batteries called *Salva la Selva*, which is unique in the region, for most batteries are simply thrown away in backyards or water courses.

Figure 9: Stockage of recyclable materials in Iquito.



Source: CIDADE, Fernanda. Set. 2014

Rubbish in the city is a visible problem, as in all Amazonian cities, and the open-air landfill has an impressive population of waste pickers and their families working in degradation conditions, not much different from other cities analyzed.

The commercial hub of recyclable materials in Manaus.

The competition for recyclable materials in Amazonas state, Brazil, by various organizational sectors, both private and social (represented by collectors), causes layoffs in the post-consumer reverse supply chain. These layoffs become evident when one realizes that both *sucatarias* as cooperatives and associations have their own commercial networks, however, organized in different levels.

Manaus, a historical and port city, located in the center of the Amazon at the confluence of the Negro and Solimões is the capital of the Amazonas state. Manaus as a capital is also the main financial, corporate and economic center of Northern Region of Brazil. With the creation of the Industrial Pole of Manaus in 1967, the city became one of the largest industrial centers of the country.

Manaus concentrates all the commercialization of recyclable materials from the Amazonas state. In all cities studied, the Amazonas state, Manaus is the destination of recyclable materials collected, becoming the central nodule of reception and distribution of recyclables.

Research in Manaus showed that commercial network of recyclable materials may be based on levels. These levels are connected to the network hierarchy, i.e., each

level is proportional to the hierarchy in the network and proceeds at this level. The higher the level more complex is the network. Four distinct levels were identified.

Level 1 is characterized by informal collectors, who are not organized into cooperatives or associations, but are of great significance for the network. These collectors are often practicing this activity in order to increase their family income or, being retired, housewives, owners of small bars, in short, anyone who is willing to store a certain amount of some kind of recyclable material to later sell to sucatarias in the neighborhoods (small sucatarias) that make up the level 2 network. It is noteworthy that at level 1 of this network, the materials that are collected are more non-ferrous materials such as aluminum cans, copper, batteries and aluminum.

The small sucatarias are scattered around Manaus forming a disperse level 2 in the network. Thus, these sucatarias function as storage sheds where the separation phase of recyclable materials is done. The maintenance of these sucatarias depend on the input from the level 1 so it can be made a separation and grouping of all recyclable until they reach a significant amount to be sold to larger sucatarias, classified at level 3.

Some of these level 2sucatarias have a car system that has a neighbourhood schedule for collecting recyclables, specially non-ferrous materials, from houses, paying for the material and gathering an important amount.

The large sucatarias are present in Manaus, level 3 of the network, receive recyclables from other municipalities in the state and are the link between the commercial networks of the state of Amazonas recyclable materials with the reverse production chain in Brazil. At this level, there are also cooperatives and associations of collectors, because this stage is made by the receiving and distribution of recyclable materials to recycling industries.

These industries make the recycling process and compose the level 4 of the commercial network, and the final destination of collected recyclables in the state. Collectors organized in their cooperatives and associations also have a peculiarity in the commercial network of recyclable materials, because they work with materials with lower economic value, different from the material commercialized by sucatarias such as paper, cardboard, PET bottles and plastic.

These collectors end up forming a parallel commercial network of recyclable materials because somehow find them integrated and at the same time members of all stages of marketing of recyclable. Since they are collecting, separating and distributing recyclable materials to recycling industries, given that in Manaus industries that recycle paper, cardboard and PET bottles are made present.

One of the existing cooperatives in the capital is Eco Cooperative Manaus that can be seen as a representative of the network to which it is inserted. Its operation is given in an interactive way with the "local points /sucatarias" of the cooperative that is present in some of the neighboring cities. The local points, sucatarias, are small warehouses located in strategic areas of the city, where all collected recyclable material are stored and subsequently taken to the central warehouse to be separated, correctly compressed, and then sold to the reverse industry.

The research also accompanied what the municipal and state competent bodies are doing and not doing for the fulfillment of the Law 12.305 / 2010, since the period of adjustment ended in 2014 as previously mentioned. On June 5, 2013 was held the III

Municipal Environmental Conference in Manaus. The purpose of the conference was to present the concerns, share responsibilities and make claims and suggestions that improve the environmental policy of the Amazonas municipalities.

The Secretary of State for the Environment and Sustainable Development (SDS) held in the period 11th and 14 November 2013, the 7th Permanent Forum of Municipal Secretaries of the Amazon Environment (Fopes-AM) and the International Workshop on Solid Waste. The forum aimed to enable environmental managers with a view to strengthening environmental management of municipal and state systems of environment.

In this forum, attended by all municipal secretaries of Environment, it is noticeable that the general concern is in suiting article of the Brazilian law 12.305 / 2010 which extinguishes the current open landfills replacing them with correct landfills. This concern comes about not only because of the fulfillment of the law is necessary for municipalities to have access to union resources but also because city managers understand that the construction of the landfill is the ultimate solution to the problem of the destination of solid waste their cities and not the beginning of a set of actions that involve the management of solid waste.

It is true that the reuse of waste can be a way to reduce rampant extraction of raw materials, but does not remove the problem of destruction / creation (RODRIGUES, 1998), because though the reuse and recycling is a mitigating activity in the actions in favor of the environment, it still generates impact, especially of social character. The two commercial network of recyclable materials, *sucatarias* and cooperatives / associations, although they have their different commercial stages, the meeting point is established in the destination of the materials. Thus, we see the dependence of the networks to recycling industries, which seek only their own profit at the expense of all the environmental discourse in which it is supported. While municipal governments are not qualified and prepared for the implementation of the Brazilian national policy of solid waste the commercial network along the Solimões-Amazonas River depends on the *sucatarias* and their monopsony, maintaining terrible work conditions and social exclusion of the scrap collectors.

CONCLUSION

In this study, we analyzed Brazilian cities located along the Solimões-Amazonas and the Peruvian city of Iquitos located along the Amazon River. The Brazilian municipalities in the region have the lowest indices of social development, not only of the Amazon but also in Brazil. Family farming practiced in the Amazon and therefore in this micro region is strongly based in the production of flour, fruits especially banana, pineapple, watermelon, some tubercles. This is the same case for the Peruvian Amazon.

In this context, collection of recyclable materials is an important source of income for families that live in the cities and in the rural communities. The analyzed commercial network is strongly concentrated in the hands of few, dependent on the *sucatarias* (Brazil) or *chatarras* (Peru), with low technology, and an informal working system where the collectors are the most fragile nodule in the network.

It is true that the reuse of waste can be a way to reduce rampant extraction of raw materials and increment family earnings, but does not remove the problem of destruction (RODRIGUES, 1998), because though the reuse and recycling is a mitigating activity in the actions in favor of the environment, it still generates impact, especially of social character. In the commercial network of recyclable materials, *sucatarias*, *chatarras* and cooperatives/associations, although they have their different commercial stages, export the collected material to far away regions where the recycling industries are present. Although they do not work with the same materials, the complete recycling process is done in far off industries not aggregating value to the local commercial chain.

Thus, we see the dependence of the networks to the recycling industries, which seek only their own profit at the expense of all the environmental discourse in which it is supported. While municipal governments are not qualified and prepared for the implementation of the Brazilian national policy of solid waste, the fragile side of the network, the collectors continue to be subsumed in exploitation.

No innovative technology, environmentally friendly and socially just is being incorporated in the commercial network analyzed. It is urgent that local and national authorities enforce the incorporation of innovative processes not only in the reversal industrial but also in the most fragile side of the network: the waste pickers. Innovations in organization and in working processes that can enforce and strengthen the waste pickers organization stimulating sustainability in a broader sense is a *sine qua non* condition for sustainability.

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