Recyclable Plastics Supply Chain in Brazil

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THE PROBLEM

LINEAR ECONOMY

RESOURCE EXTRACTION → PRODUCTION → DISTRIBUTION → CONSUMPTION → WASTE

Image: http://sustainablebrandsmadrid.com/blog/wp-content/uploads/2016/03/circularEconomy-Top9.png

Sources: VELIS; BRUNNER (2013); VELIS (2015a).

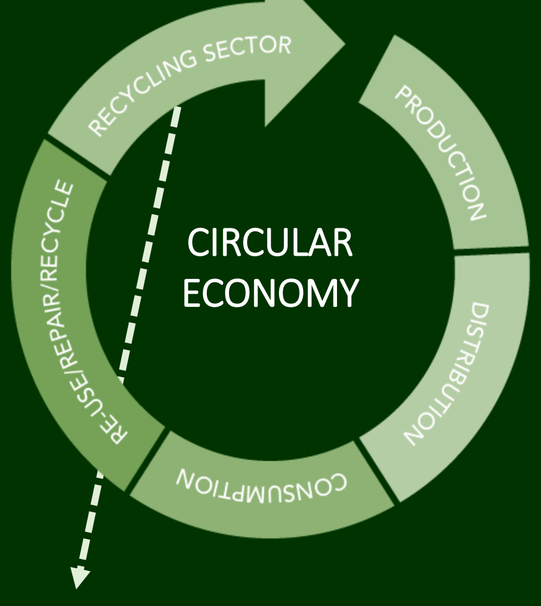

Image: https://www.nationalgeographic.com/content/dam/magazine/rights-exempt/2018/06/plastic-animals/plastic-waste-single-use-worldwide-consumption-animals-2.adapt.676.1.jpg

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Image: https://www.nationalgeographic.com/content/dam/magazine/rights-exempt/2018/06/plastic/plastic-waste-single-use-worldwide-consumption-1.adapt.1190.1.jpg

PLASTICS FACTS

1. World plastic **production** has **increased exponentially** from 2.3 million tons in 1950 to 162 million in 1993 to 448 million by 2015.
2. More than **6.9 billion tons of plastic waste** had been generated: **9% was recycled, 12% incinerated, 79% accumulated in landfills or environment.**
3. The **largest market** for plastics today is **packaging** materials. More than 40 percent of plastic is used just once, then tossed.
4. Worldwide, **73% of beach litter is plastic**: filters from cigarette butts, bottles, bottle caps, food wrappers, grocery bags, and polystyrene containers.
5. More than **5 trillion pieces** of plastic are already floating in our **oceans**.
6. Some **700 species** of marine animals have been reported so far to **have eaten or become entangled** in plastic.
7. Estimates for how long plastic endures range from **450 years to forever**.

Sources: UNEP, 2014; UNEP, 2015; VELIS; BRUNNER, 2013; VELIS, 2015a; WORLD ECONOMIC FORUM et al., 2016; EC, 2015; GEYER; JAMBECK; LAVENDER LAW, 2017; NATIONAL GEOGRAPHIC, 2018.

RECYCLING IS PART OF THE SOLUTION!

It depends on a **reverse supply chain**, with source segregation, collection, sorting, mechanical processing and trading materials in local and international markets (JALIGOT et al., 2016).

Each of these steps involve **different actors**, including waste pickers and collectors, governments, transporters, service providers, material traders and recyclers (VELIS, 2015b; SCHEINBERG; SIMPSON, 2015).

According to Jambeck et al. (2015), **Brazil** is the **16th** country in the world that mismanages plastic waste with approximately 70,000 to 190,000 tons of plastics that ended up in the ocean in one year, which shows the great importance of an efficient reverse supply chain in place to recover plastics before it reaches the oceans.

Decision making, policies and regulations have been created to manage this complex process. Brazil has approved its **National Solid Waste Management Policy in 2010** [PNRS, in Portuguese] (BRAZIL, 2010; RUTKOWSKI; RUTKOWSKI, 2015; LIMA; MANCINI, 2017).

The **PNRS adapted the extended producer responsibility principle to the shared responsibility principle**, so the National Government has been negotiating with representatives from the private sector and the waste pickers to create an effective **reverse logistics system** for post-consumer packaging waste (SNIR, 2015).

Data monitoring through these transactions is very rare at Municipal, State or National levels. 5 studies on recyclable materials supply chains in Brazil (IBAM, 2012; CEMPRE, 2014; ZANIN; MANCINI, 2015; RUTKOWSKI; RUTKOWSKI, 2017; COELHO; CASTRO; GOBBO JR., 2011) allowed for clarification of how recyclable materials' supply chains work, but **little is known about the actual material, financial and technical flows of these chains**.

We will **evaluate the Brazilian recyclable plastics supply chain** by:

- Mapping actors from a recyclable plastics supply chain, starting in Cachoeira de Minas;
- Quantifying the material and financial flows in each step of the chain;
- Describing technologies and techniques applied for each stage;
- Describing material quality in each stage;
- Evaluating the dynamics of a recyclable plastics supply chain in Brazil.

RESEARCH STRATEGY

- **Research strategy** will be to conduct a case study, that allows access to data from all actors involved in the chain, making it possible to have a clear and complete view of the chain and how it works, to understand its dynamics.
- The **sampling process** was based on the parsimony principle, by selecting the small city of Cachoeira de Minas, in the State of Minas Gerais, to explain the plastics chain dynamics in Brazil. This city was chosen because it has been studied by the research group FLUXUS at Unicamp and access to data is facilitated by established contacts.
- To **collect the data**, we will perform structured interviews, direct observation and literature review from local actors involved.
- **Data will be analyzed** through documental and discourse analysis. We intend to use two analytical tools to reach the five specific objectives: the **technical networks framework** applied in waste management by Fiore (2013) and **C-VORR framework** developed by a team at the University of Leeds (IACOVIDOU et al., 2017a; IACOVIDOU et al., 2017b).

Technical networks (TNs) are defined as systems of technical objects and flows (materials, services and information) in which connections in a territory are made. It shows connections between nodes or actors of a system, evidencing techniques and technologic flows that are existent. TN can be used as organization instruments for a territory. However, even if built, can be modified through time, because new spaces and connections are created according to the social and technological dynamics. The improvement of the performance of a TN can aim for sustainable development (FIORE, 2013).

CVORR is short for the Complex Value Optimization for Resource Recovery from Waste, an analytical framework to measure complex value, that is, the benefits (positive value) and impacts (negative value or loss of value) of resource recovered from waste holistically, in the environmental, economic, social and technical domains, what they define as "complex value". It is grounded in the systems of provision approach and aims to assess how value is created, destroyed and distributed within systems. It shows a whole-system assessment and provides an analytical method for calculating and communicating multidimensional outputs, to support decision making (IACOVIDOU et al., 2017a; IACOVIDOU et al., 2017b).

CLOSING REMARKS

The supervisors of this project were carefully selected. The student, **Nathalia Lima**, has worked with academic and professional projects within the theme in Brazil and abroad. She has two scientific research initiation projects; 3 internships in the Netherlands, United States and Greece; participation at the World ISWA Congresses 2013-2018 and 1 publication in the journal *Waste Management & Research* (https://doi.org/10.1177/0734242X17708050). She worked for 3 years at a Brazilian consulting firm having contacted diverse recycling actors and visited many cities to design and implement reverse logistics and shared responsibilities projects.

This project is going to be the basis to understand the dynamics in the recyclable plastics supply chains, which will contribute to the theme and will raise important questions to include the complexity of reality from recycling markets in public policies that are more inclusive and fair, not only in Brazil, but other countries.

Additionally, this base analysis will be used in a future doctorate research, through which we intend to incorporate mathematical modelling, in order to optimize the technical network to maximize the complex value generation in plastics supply chains and contribute to smart decision making processes.

The supervisor **Dr. Emília Wanda Rutkowski** is an associate professor at University of Campinas. She coordinates FLUXUS, one of the research groups from the Laboratory in Technical Networks and Social and Environmental Sustainability, where there are lines of research concerning cities, education and policies.

Co-Supervisor **Dr. Costas Velis** is a professor at the University of Leeds. He coordinates the Circular Economy & Resource Efficiency Network and has been awarded for his studies on the integration of informal sector recycling. . In 2015, his team got a grant by NERC to conduct a research on Complex Value Resource Recovery Optimization (C-VORR) and create a tool to measure the complex value of materials recovery systems.

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