



MAP OF RISKS IN COOPERATIVES OF COLLECTORS OF RECYCLABLE MATERIALS IN THE MUNICIPALITY OF CAMPINA GRANDE-PB

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ABSTRACT

The aim of this article is to evaluate the physical, biological, chemical, and ergonomic risks, as well as the risks of work accidents in recyclable waste collectors' cooperatives in the city of Campina Grande, PB, through the elaboration of a Risk Map. As for the methodology, it is a study of multiple cases, classified as descriptive, qualitative and non-participant observation. For the data collection, a documentary research was carried out, an on-site visit with a check list of possible risks, photographic records and interviews with the cooperatives of the cooperatives involved in the collection, selection and handling of recyclable materials exposed to various risks in the work environment. Risk mapping was based on the Risk Map, considering the biological, chemical, ergonomic, physical and occupational accident risks, based on the work of Schneider et Gervanutti (2014). The results show that the storage of the recyclable materials and the operational techniques used for compaction, selection and storage generate situations of continuous risk to the occurrence of accidents, mainly due to the absence of use of specific protection equipment for each operation. In addition, precariousness in the work environment also enhances the operational risks inherent in the processing and storage of these materials, increasing the possibilities of accidents that may compromise the health and productivity of workers in the cooperatives studied.

Keywords: Solid waste; Recyclable materials; Cooperatives; Workers; Risk Map.



1. INTRODUCTION

The growing development of cities and, consequently, the exacerbated population growth, has promoted that the environment undergo diverse alterations, which culminate in the reduction of the quality of life of the community, giving rise to a worldwide concern with regard to solid residues, which has increased in the face of production growth, the inefficiency of waste management and the lack of suitable areas for the final disposal of tailings produced by human action.

The disposal of urban waste improperly entails the most varied public health problems, since this waste facilitates the propagation of vectors, such as flies, cockroaches, rats, etc. In addition, urban waste, when improperly disposed of, is responsible for the generation of odors as well as pollution of the soil and surface and groundwater reservoirs (Mucelin et Bellini, 2008).

In the perspective of acting to solve the problem concerning the production of garbage, Brazilian legislation has, in environmental law, one of the most complete norms, when compared to foreign laws. And specifically with regard to solid waste and the selective collection of recyclable materials, the National Policy on Solid Waste has been instituted, through Law 12,305 of 2010. The law refers to management mechanisms and management of solid waste that, among other factors, include the insertion and organization of recyclable waste collectors in the municipal selective collection systems, aiming at effective means for the collection, transportation, transshipment, treatment and environmental disposal of solid wastes and the final environmentally appropriate disposition of tailings produced (Brasil, 2010).

It is also worth mentioning that the inadequate disposition of solid waste generates other consequences, such as the unhealthy disposal in the streets and in the final disposal areas, leading to social and environmental risks (Besen et al, 2010). In this sense, the inclusion of collectors of recyclable materials in the selective collection services became the subject of study of several areas. For the experts, waste pickers are considered important allies in the execution of urban cleaning services, because, in performing the selective collection, they avoid the sending of recyclable material to the sanitary landfills, contributing to increase the recycling of materials and, consequently, the environmental preservation.

The labor activity performed by these collectors consists of collecting, separating, transporting, conditioning and even benefiting solid waste, giving them market value to be reused or directed to recycling processes. As garbage gains value through its work, the collector “ends

up renaming it, fueling the very process of positive resignification of its labor activity” (Benvindo, 2010, p.71) and one of the ways of organizing workers collecting recyclable material occurs through the formation of cooperatives.

Cooperative work brings a number of benefits to workers. However, people working in cooperatives of recyclable materials are susceptible to a number of exposures and direct contact with recyclable materials, such as: exposure to heat, humidity, noise, rain, the risk of falls, cuts and bites of venomous animals in the debris, contact with rats and flies, the smell of gases and smoke that exude from accumulated solid waste, work overload and weight lifting, and contamination by biological or chemical materials. These risks make the activity considered unhealthy to a maximum extent, in accordance with Regulation No. 15 of the Ministry of Labor and Employment (MTE), requiring greater care in terms of protective equipment and the availability of suitable sites for the execution of the work (Oliveira, 2011).

In this sense, the object of study are cooperatives of collectors of recyclable materials of the Municipality of Campina Grande-PB; they are: ARENSA Association; CAVI Association; CATAMAIS Cooperative and the CONTRAMARE Cooperative. Due to the magnitude of the risks of accidents inherent in the work of recycling recycled material, and in accordance with the socio-environmental, labor and health complications that workers are exposed to, the present study was prepared. In this sense, the article aims to evaluate the physical, biological, chemical, ergonomic and work-related risks in recyclable waste collectors’ cooperatives in the Municipality of Campina Grande, PB, through the elaboration of a Risk Map.

The relevance of this study is to qualify and size the risks that the workers of the cooperatives that handle the waste are exposed daily and that can compromise the health and the quality of life and, with this, to seek improvements for the work environment of the workers. Considering the importance of these professionals and recycling cooperatives for the sustainability of the planet, this analysis makes it possible to identify more efficient measures or forms of management for the cooperatives under study and, consequently, a significant step towards solid waste management in the Municipality of Campina Grande.

2. SOLID WASTE MANAGEMENT

In anticipation of solid waste issues and their relationship with society and the environment, the Federal Constitution, in its Article 182, addresses this issue, em-



phasizing that the urban development policy must be implemented by the municipal public authority according to guidelines established by law and have the purpose of ordering the full development of the social functions of the city and guaranteeing the well-being of its inhabitants (Brasil, 1988).

According to current legislation, there are appropriate ways of treating and packaging solid waste, such as the implementation of selective collection systems and the subsequent referral to landfills. However, according to data from the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* - IBGE, 2010) and the National Plan for Solid Waste (2012), the accumulation of open garbage is still prevalent in cities, usually in areas surrounding the urban area, such as is the case of poorly designed dumps or landfills, which, because they present 60% of organic matter, they make the surrounding environment conducive to the proliferation of micro and macro vectors such as viruses, bacteria, fungi, mosquitoes, flies, cockroaches, rats and birds, which cause disorders to the public health and have socio-economic and environmental impacts for the communities, being the most intense damage to the population of these places.

In this context, Law no. 12.305, which deals with the National Solid Waste Policy (PNRS), defining integrated solid waste management as a set of actions aimed at finding solutions for such waste, in order to consider the political, economic, environmental, cultural and social dimensions, with social control and under the premise of sustainable development. In order to do so, the management of Solid Waste has as principle the systemic view, due to the need to encompass a set of dimensions seen and analyzed in an integrated way (Brasil, 2010).

Studies focused on the evaluation of the impacts caused by the deposition of urban waste are indeed preponderant, since they are capable of diagnosing the impacts that these ventures have on the environment, as well as on the health of the local community. In this context, the neighborhood impact study, presented in the City Statute (Law No. 10.257/2001), in its Articles 36 and 37, appears as a specific instrument for environmental impact assessment for cities, with the main objective of establishing the positive or negative effects of the implementation of an activity or undertaking in an urban area, focusing on the quality of life of the resident population in the vicinity.

Law No. 12,305/2010, in its 3rd article, subsection XVI, defines solid waste as: material, substance, object or asset discarded, resulting from human activities in society, whose final destination is proceeding, is proposed to

proceed or is required to proceed, in solid or semi-solid states, as well as gases contained in containers and liquids whose particularities make it unfeasible for them to be put into the public sewage system or bodies of water or require technical or economically viable solutions in the face of the best available technology.

There are several ways to classify solid waste. The most common are the potential risks of contamination of the environment and nature or origin. Regarding the potential risks of contamination of the environment, in accordance with ABNT NBR 10.004, solid wastes can be classified as (ABNT, 2004):

a) **Class I Residues:** Hazardous: They are those that, due to their physical, chemical or infectious-contagious properties, may present: Risks to public health, causing mortality, incidence of diseases or accentuating their indexes; Risks to the environment when the waste is improperly managed.

b) **Class II Residues:** Non-Hazardous: Those that do not present dangerousness, for example: scrap, plastic, glass, paper, cardboard, etc. Class IIA: Not inert: They exhibit biodegradability, combustibility and solubility in water. Class IIB: Inert: Any residues that, when sampled in a representative manner, and subjected to a dynamic and static contact with distilled or deionized water at ambient temperature, do not have any of their constituents solubilized at concentrations higher than the water potability standards, except for the appearance, color, turbidity, hardness and taste.

The origin is the main element for the solid waste characterization. According to this criterion, the different types of waste can be grouped in seven origins: household, commercial, health service, public service, agricultural, industrial and rubble. Part of these residues, especially household and commercial waste, when there is no selective collection at the source of origin, become waste to be collected, separated and sent for revaluation, through the work of individual or collective collectors, organized in cooperatives or associations. The activity of these workers has great relevance to minimize the impacts caused by the amount of solid waste generated and discarded inappropriately. On the other hand, they are targets of risks to the health and quality of life of these workers.

The role of cooperatives in solid waste management and risks to the worker

In several regions of Brazil, the formation of recycling cooperatives has been the object of investigation of re-



searches that show the importance of this activity to mitigate the environmental impact of solid urban waste, through the work of selective garbage collection. However, studies also show the difficulties of the collectors who begin to organize themselves in cooperatives, with the still precarious support of the public and private sectors and of civil society (Souza, 2012).

In 2008, there was the First World Congress of Waste Recyclers, bringing together representatives from countries in Latin America, Asia, Africa and Europe in Bogota, Colombia. The proposals included in the declarations signed by the participants of this congress are: the commitment to work for the social and economic inclusion of the population of collectors of recyclable materials and the promotion of the value chain, so that they can enjoy the benefits generated by the activity developed (World Conference of Collectors of Recyclable Materials, 2008).

It is worth noting that cooperatives contribute to the extension of the useful life of products and packaging through the collection, separation and supply of secondary raw material for the industry. In this way, the reverse logistics programs of companies that seek the recovery of recyclable products are consolidated. In this sense, the main issue of reverse logistics is the equation of the paths covered by the goods or their constituent materials after the end of their useful life. These goods or materials are transformed into the so-called post-consumer products and can be sent to traditional final destinations, such as incineration or landfill, or to return to the production cycle through the channels of dismantling, recycling or reuse.

Through the above, it is understood that the role of cooperatives in the reverse chain is to recover after-consumption materials and serve as a supplier of raw materials for the industry. In addition, cooperatives play a social role with low-income communities, as they offer alternative employment and income, and environmental role, as they contribute to reduce pressure on landfills and incineration of solid urban waste (Almeida, et al 2013). On the other hand, often the environment of cooperatives and the handling of waste generate risks for the worker.

One way to improve these spaces can be by drawing up risk maps. Schneider et Gervanutti (2014) emphasize that the risk map aims to gather the necessary information to establish the diagnosis of the occupational safety and health situation in the company, and to enable the exchange and dissemination of information among workers, involving them to participate in prevention activities.

Risks are classified into five types: physical risks, chemical risks, biological risks, ergonomic risks and accident risks. Each of these types is responsible for different environmental hazards that may cause damage to workers' occupational health (SEGPLAN, 2018). They are **physical hazards**: noise, vibration, ionizing radiations, non-ionizing radiation, extreme temperatures, abnormal pressures, and humidity; **chemical risks**: dust, fumes, mists, fogs, gases, vapors, composite substances or chemicals; **biological risks**: viruses, bacteria, protozoa, fungi, parasites, and bacilli; **ergonomic risks**: intense physical exertion, weight lifting and manual transport, inadequate posture, rigid control of productivity, imposition of excessive rhythms, night shift work, prolonged working hours, monotony and repetitiveness, among others; **accident risks**: inadequate physical arrangement, unprotected machinery and equipment, inadequate and defective tools, inadequate lighting, electricity, fire and explosion probability, improper storage, venomous animals, among others (Schneider et Gervanutti, 2014).

The stages for drawing up the risk map are highlighted: 1) to know the work process in the analyzed place; 2) identify existing risks; 3) preventive measures and their effectiveness; 4) health indicators; 5) know the environmental surveys already carried out on site; 6) to elaborate the Risk Map, on the layout of the company, indicating, by means of a circle, the group to which the risk belongs, according to the standardized color, number of workers exposed to the risk; specialization of the agent, intensity of risk, according to the perception of the workers, which should be represented by proportionally different sizes of circles.

From the identification of the risks it is possible to improve the management of the cooperatives and, consequently, to reduce the risks inherent to the processes that can harm the health of the workers.

3. MATERIAL AND METHODS

The objective of this research was to evaluate the physical, biological, chemical, ergonomic and work-related risks of recyclable waste collectors' cooperatives in the Municipality of Campina Grande, PB, by means of the elaboration of a Risk Map. The Cooperatives investigated were those registered in the City Hall of Campina Grande-PB: Cavi, Catamais, Contramaré and Arensa; thus, it constitutes a study of multiple cases.

This is a descriptive research, using a qualitative approach, since it sought to describe the characteristics of cooperatives, to identify and qualify the risks to which workers are exposed in the work environment.



For the collection of information, interviews with cooperative members of the cooperatives were used, as well as non-participant observation in loco by filling a check list to identify the risks and the photographic record of the work environment. The documentary research was also used in the investigation, by consulting data provided by the management of the cooperatives themselves.

Risk mapping was based on the Risk Map, considering the physical, biological, chemical, ergonomic and work-related risks, based on Schneider & Gervanutti's (2014) study. Table 1 shows the variables considered in the research that guided the results achieved.

Regarding the intensity of the aspects related to the different types of risks, three categories were considered: light, average and high risk.

In the data treatment and analysis of the results, triangulation of the data, both primary and secondary, was used in light of the theoretical bases that guided the study.

4. DISCUSSION OF RESULTS

Characterization of garbage collectors cooperatives in Campina Grande-PB

According to the research carried out, the distribution of workers in the cooperatives under study is presented as follows: ARENSA Association, 16 workers; CAVI Association, 08 workers; CATAMAIS Cooperative, 09 workers; and the CONTRAMARÉ Cooperative with 15 workers. These institutions are registered in the secretariat of Urban Services and Environment of the Municipality of Campina Grande-PB.

The administrators of the associations and cooperatives are all collector-cooperators and the administration is composed only by the president and the vice-president of the organizations. In this way, the remuneration of the cooperative is given through the persons who are administrators in charge (presidents) for the cooperatives and associations, with a fair division of the total profit

Table 01. Aspects of Risk Map and Intensity

RISKS	TYPES	RISK INTENSITY	
		Risk Level	Visual Representation
Physical	Noise, Vibrations, Radiation, Cold, Heat AND Humidity	Light physical risk	
		Average physical risk	
		High physical risk	
Chemicals	Dust, Gases, Vapors, Composite Substances AND Chemicals	Light chemical risk	
		Average chemical risk	
		High chemical risk	
Biological	Bacteria, Bacilli, Fungi, Protozoan, Parasites AND Viruses	Light biological risk	
		Average biological risk	
		High biological risk	
Ergonomic	Intense physical exertion, Weight transport, Inadequate posture, Excessive rhythm, Long and repetitive journey	Light ergonomic risk	
		Average ergonomic risk	
		High ergonomic risk	
Work accident	Physical Arrangement, Lack of EPC, Improvised Tools, Low Illumination, Fire Risk AND Storage	Light accident risk	
		Average accident risk	
		High accident risk	

Source: based on Schneider et Gervanutti (2014).



by the number of cooperative members, less the costs of supplying fuel for the truck that performs the collection. Always taking into account that the division obeys the criterion of hours worked, that is, those who work the most will receive more and vice versa.

In the municipality of Campina Grande there is no selective waste collection. Thus, the waste generated throughout the municipality is collected on a regular basis (3 days a week) by trucks from the city and sent directly to the landfill. According to the interviewees, the Cooperatives do not collect landfill or dump material. The recyclable materials that are processed by the cooperatives and associations come from different places, such as: houses, hospitals, pharmacies, supermarkets, concessionaires, banks, fuel stations and construction material stores.

Regarding the participation of the Cooperatives in the solid waste collection system in the Municipality, the respondents answered that they collect material from several institutions in a systematic and door-to-door manner in the neighborhoods, where there are residents who are willing to help the recycling associations and cooperatives. The door-to-door collection occurs because there are agreements with several commercial establishments to collect recyclable materials, as well as selective collection in associations of residents of some districts of Campina Grande, which perform previous separation of materials that can be recycled, and the cooperated professionals periodically to carry out the collection.

As for the material processed in the cooperatives, the interviewees informed the types of materials, according to Table 02.

In Table 2, it is observed that all cooperatives collect paper, metal and plastic; two cooperatives collect electronic components and two collect glass; and none of the institutions carries out the collection of organic material. Waste pickers say that recyclables always come

with some kind of waste, such as toilet paper, gases, etc., since they all take out some kind of waste that comes along with recyclables collected from contractors. These wastes are directed to the landfill.

The selection of recyclable materials is an important step in the disposal of municipal solid waste; however, there is no selective collection of waste generated in the municipality. Therefore, after the selection made by the people in the houses and in the agreed institutions, there is, in all the cooperatives, the separation of the materials.



Figure 1. Manual cars used by the cooperatives of Campina Grande

Source: the authors

The workers reported the difficulty they have to perform the collection in the supplier units. This collection is performed by a truck purchased with CATA-PB Network resources and a driver provided by the city hall. The available truck is only available once or twice a week, depending on the cooperative, and even then, the fuel is paid by the cooperative or association that requests it. On the other days, the collectors are collecting recyclable materials with the help of hand-carts (Figure 1), distances of more than 04 kilometers, which increases the physical effort and exposes workers to risk of traffic accidents through dimensions of the used car and lack of infrastructure of the streets to allow the passage of the collectors with greater safety.

Table 02. Types of materials collected by cooperatives

COOPERATIVES	Type of Material		
	Dry	Organic	Waste
I. CATAMAIS	Paper, metal and plastic.	Do not collect	Remains of cotton, gas, diapers and toilet paper.
II. COTRAMARE	Paper, metal, plastic and electronic components.	Do not collect	Remains of cotton, gas, diapers and toilet paper.
III. ARENSA	Paper, metal, plastic, glass and electronic components.	Do not collect	Remains of cotton, gas, diapers and toilet paper.
IV. CAVI	Paper, metal, plastic and glass.	Do not collect	Remains of cotton, gas, diapers and toilet paper.

Source: the authors



Since Campina Grande has a municipal solid waste plan, it was sought to identify whether the Cooperatives receive support from the Municipality through technical assistance, equipment and real estate, and all said that they do not receive this support. They emphasized that the UEPB and the UFCG, through teachers, promoted some training and guidance in the management of institutions, in order to reduce the social and labor inclusion difficulties of the collectors.

In order to improve knowledge and practice in the handling of recyclable materials, the cooperatives participate in a continuous training process, which are offered by the institutions: UEPB, UFCG and SETRAC together with the CATAFORTE Network. In these trainings, guidance is also provided on how cooperatives are to maintain business relationships in the sale of recycled materials for higher profit margin. Yet, the cooperatives researched still sell the recyclable materials to intermediaries and said they are aware of the damage, but that the advantage is to receive the payment immediately.

Some agencies, such as the State University of Paraíba (UEPB) and the Cultural Action Center-SENTRAC also provide some of the Personal Protection Equipment (PPEs) that the collectors use, which are distributed once a year. This linkage of the UEPB with the cooperatives takes place for the conducting of researches and the provision of the PPEs would be the responsibility of the City Hall of Campina Grande.

As for the work place, the City Hall gives ground or shed to the activities of two cooperatives. As for the others, one has a shed loaned by a support institution

and the other pays the expenses of its place of work with its own resources. As far as the financial resources for maintaining cooperatives are concerned, according to the cooperative, the cooperatives do not receive financial resources from the municipality.

As for the working day, representatives of cooperatives and all cooperative professionals stated that they have a daily workload (Monday to Friday) of 8 hours a day. On the other hand, according to what was seen during the visit in these places, some members of the cooperative receive an income lower than a minimum wage (this finding occurred because one of the visits took place on the day of payment of the work activities). The fact that these workers receive wages lower than the minimum wage, which is established by the federal government, is contrary to what is provided in Law No. 12,690 of July 20, 2012, which deals with the organization and operation of Labor Cooperatives and establishes the National Program for the Promotion of Labor Cooperatives – PRO-NACOOP, stating in its Article 7, regarding guarantees to the worker, that withdrawals must not be lower than the minimum wage of the professional category and, in the absence thereof, not lower than the minimum wage, calculated proportionally to the hours worked or to the activities carried out in the labor cooperative.

In addition to these difficulties and confrontation experienced by the cooperative, in order to better understand the risks inherent to the solid waste separation work carried out by the cooperatives, the physical, biological, chemical, ergonomic and work-related risks in the cooperatives' environment will be analyzed.

Table 03. Map of Physical Risks of Cooperatives

Cooperatives	Presence of Physical Risks, Reasons and Intensity *					
	Noise	Vibrations	Radiation	Cold	Heat	Humidity
I. CATAMAIS	Electrical press ●	Electrical press ●	No -	No -	Electrical press/ environment ●	Rain ●
II. COTRAMARE	Electrical Press ●	Electrical Press ●	No -	No -	Electrical Press/ environment ●	No -
III. ARENSA	No -	No -	No -	No -	Environment ●	Rain ●
IV. CAVI	Electrical Press ●	Electrical Press ●	No -	No -	Electrical Press/ environment ●	No -

Subtitle: * ● light ● Average ● Moderate

Source: Direct research (2016) based on Schneider & Gervanutti (2014)



Risks to workers in the workplace in the cooperatives under study

Risk maps were elaborated, where physical, biological, chemical, ergonomic and work-related risks were analyzed in the four cooperatives under study, located in the city of Campina Grande.

The **map of physical risks** analyzed the aspects: noises, vibrations, radiation, cold, heat and unity, seeking to size these risks as light, average and high in the cooperative environment, according to Table 03.

It is verified that **noise** and **vibrations** are present in three cooperatives analyzed with high intensity. Noise and vibration are caused by the electric press. Cooperativa III does not have an electric press, thus, all the material is compacted manually. The risks of **radiation** and **cold** were not verified in the cooperatives, because they did not work with materials with these characteristics. As for the issue of vibrations, these occur with the cooperate professionals that operate the press and only at the time of compacting the material. As for **heat**, it was found that all Cooperatives are exposed to the risk of heat; therefore, Cooperatives I, II and III were evaluated with medium intensity and IV with high intensity. The greatest heat dissipation is caused by the electric press. The environment and the electric oven are the reasons for the existence of heat in the work environment. **Humidity** is present in Cooperatives I and III, caused by rain, occasionally occurring in rainy periods when rainwater flows into the work environment forming pools of water.

Regarding the **Chemical Risks Map**, the following aspects were analyzed: dust, gases, vapors, composite substances and chemicals in the Cooperatives' environment, according to Table 04.

About chemical risks, dust is present in all Cooperatives. It is noteworthy that, since most recyclables are made up of paper and cardboard and the waste pickers work without the use of a mask, the inhalation of dust is frequent and the risk is high. Figures 2 and 3 show the amount of paper and paperboard stored in cooperatives.

As for the **gases**, it was verified the existence of materials (residues of sprays and paints) responsible for the generation of gases in two cooperatives. The same behavior was observed in relation to the presence of **composite substances** (insecticide sprays and paints) and the handling of **chemical products'** containers (cans and bottles in cooperatives I and III). It is important to note that these cooperatives do not receive these materials to be processed and sold, so the risks were considered of medium intensity. Even though they do not receive containers that have been used for the storage of chemical products or compounds, such as paint cans, insecticide sprays, or other materials used for chemicals, they report that these materials often come together with others that are collected, which have to be separated, to be sold later. Cooperativa IV stated that it does not receive containers that have been used for the storage of chemical products or compounds, nor does it commercialize them, and states that the bottles used for handicraft manufacture come only from various beverages.

Table 04. Map of Chemical Risks of Cooperatives

Cooperatives	Chemical Risks and Intensity*				
	Dust	Gases	Vapors	Composite Substances	Chemical products
I. CATAMAIS	Paper and cardboard ●	Remainders of sprays and paints ●	No -	Insecticide sprays and paints ●	Cans and various bottles ●
II. COTRAMARE	Paper and cardboard ●	No -	No -	No -	No -
III. ARENSA	Paper and cardboard ●	Remainders of sprays and paints ●	No -	Insecticide sprays and paints ●	Cans and various bottles ●
IV. CAVI	Paper and cardboard ●	No -	No -	No -	No -

Subtitle: * ● Light ● Average ● High

Source: Direct research (2016) based on Schneider & Gervanutti (2014).



Figures 2 and 3. Paper and cardboard collected by cooperatives
Source: the authors

Regarding the **Biological Risk Map**, the following aspects were analyzed: bacteria, bacilli, fungi, protozoa, parasites and viruses in the Cooperatives' environment, according to Table 05.

The analysis of Table 05 shows that the biological risks (bacteria, bacilli, fungi, protozoa, parasites and viruses) are present in all cooperatives, with a high intensity in Cooperatives I, II and III; and with medium intensity in Cooperativa IV, due to domestic waste. Figures 4 and 5 depict the material that is collected.

During the visits, representatives of institutions I and III reported receiving materials from hospitals, clinics and homes, which come with some type of contamination, such as: diapers, absorbent, toilet paper, cotton and gases, which in turn, present high biological risk of contamination. At institution II, it was reported that the hospital material is separated in the hospital units and, in the case of other suppliers, a guidance card is given to individuals and legal entities, which instructs which types of recyclable material they can collect. However, some waste always comes with recyclables and they are sent to the landfill.

The representative of Institution IV reported that at the moment they are not receiving hospital material and that the material coming from stores of construction material is separated in the companies. He also reported that the material at risk of contamination that often comes from the agreed-upon households are baby and geriatric diapers, which are separated as tailings and sent to the landfill. However, at the time of separation, they claim to use PPE.

Table 05. Map of Biological Risks of Cooperatives

Cooperative	Biological Risks and Intensity*					
	Bacteria	Bacilli	Fungi	Protozoan	Parasites	Virus
I. CATAMAIS	Hospital material ●	Hospital material ●	Hospital material ●	Domestic RS ●	Domestic RS ●	Hospital material ●
II. COTRAMARE	Hospital material ●	Hospital material ●	Hospital material ●	Domestic RS ●	Domestic RS ●	Hospital material ●
III. ARENSA	Hospital material ●	Hospital material ●	Hospital material ●	Domestic RS ●	Domestic RS ●	Hospital material ●
IV. CAVI	Domestic RS ●	Domestic RS ●	Domestic RS ●	Domestic RS ●	Domestic RS ●	Domestic RS ●

Subtitle: * ● Light ● Average ● High

Source: Direct research (2016) based on Schneider & Gervanutti (2014).



Figures 4 and 5. Manipulation of hospital supplies and the lack of PPE and EPC in cooperatives

Source: the authors

Regarding the Map of Ergonomic Risks, the risks were analyzed according to: intense physical effort, weight lifting and transportation, inadequate posture requirement, imposition of excessive rhythms, prolonged wor-

king hours and monotony and repetitiveness in the cooperative environment, as Table 06.

The people working with the press and the manual cars for compacting the materials work hard, and this effort is verified in all Cooperatives. Institution III is the only one that does not have a press and the compaction of the materials is carried out manually, which requires a greater effort. When transporting the press material to the stockpiles or to the trucks, the cooperative professionals carry heavy materials, thus, there are high intensity ergonomic risks. The inadequate posture was verified in all Cooperatives, being more intense in Cooperatives I, II and III, in which there are no tables for separation of materials. As for the excessive rhythm, cooperative I reported that it occurs only when there is much material to be selected, separated and compacted; and Institution II said that it occurs sporadically when receiving large volumes of recyclables. Figures 6 and 7 indicate cases of ergonomic risk.

The need for prolongation of work was verified only in Cooperative IV, where there was a report that there are moments of need to prolong the journey and this fact occurs when it is close to the day of sale of the materials. In all the Cooperatives, the representatives affirmed that the work they perform is repetitive and monotonous and that, at times, the interaction between the team members and the collection in the residences are situations of physical and/or psychic stress.

Table 06. Map of Ergonomic Risks of Cooperatives

Cooperatives	Ergonomic Risks and Intensity*					
	Ergonomic Risks and Intensity	Weight transport	Inadequate posture	Excessive rhythm	long journey	Repetitive
I. CATAMAIS	Press ●	By truck ●	There is no table ●	Much material ●	No -	Monotonous ●
II. COTRAMARE	Press ●	By truck ●	There is no table ●	Sometimes ●	No -	Monotonous ●
III. ARENSA	Manual ●	By scale ●	There is no table ●	No -	No -	Monotonous ●
IV. CAVI	Press ●	By scale ●	There is no table sometimes ●	No -	Sometimes ●	Monotonous ●

Subtitle:* ● Light ● Average ● High

Source: Direct research (2016) based on Schneider & Gervanutti (2014).



Figures 6 and 7. Cluster of material to be weighed and the posture of the picker in the selection of material in the cooperatives of Campina Grande.

Source: the authors

In the **Workplace Accident Risk Map**, the risks were analyzed according to: Physical Arrangement, Lack of Collective Protection Equipment (CPE), Improvised Tools,

Low Illumination, Fire Risk, and Storage, according to Table 07.

In all Cooperatives, the physical arrangement is inadequate, either because of lack of space or because there are no specific compartments for the packaging of the materials. In only one cooperative there is a division with specific compartment for works with bottles, using the oven and a place reserved for the handmade pieces produced; however, the rest of the materials are all heaped together.

In only one of the Cooperatives there is CPE, showing greater intensity of risks in Cooperative I and II. In two institutions there is use of improvised tools, which increases the risk of an accident at work. As for workplace lighting, only one institution has good lighting.

The fire risk was considered high in three Cooperatives, due to the fact that the largest amount of recycled material is composed of paper and plastic. In Cooperative III, because the small covered area is destined for work and the stock of higher priced materials for sale, the risk of fire is lower because the material is stored outside the association. In the storage aspect, it is verified that it is inadequate in all Cooperatives, a factor that corroborates to increase the risks of accidents.

In view of the above, there is a need for a more careful look at the risks that workers are exposed to in cooperatives. Considering the importance of this work and cooperatives for the efficient management of solid

Table 07. Map of Accident Risks of Cooperatives

Cooperativas	Accident and Intensity Risks*					
	Physical arrangement	Lack of CPE	Improvised tools	Poor lighting	Fire risk	Storage
I. CATAMAIS	Inappropriate ●	Yes ●	No -	Yes ●	Paper and plastic ●	Inappropriate ●
II. COTRAMARE	Inappropriate ●	Yes ●	Pedaço de facas ●	Yes ●	Paper and plastic ●	Inappropriate ●
III. ARENSA	Inappropriate ●	There are no machines -	No -	Yes ●	Paper and plastic ●	Inappropriate ●
IV. CAVI	Inappropriate ●	There is CPE ●	Piece of glass ●	No -	Paper and plastic ●	Inappropriate ●

Subtitle:* ● Light ● Average ● High

Source: Direct research (2016) based on Schneider & Gervanutti (2014).



waste in the city of Campina Grande-PB, it is suggested that the public authorities should increase their efforts to supervise cooperatives, as well as to provide adequate conditions for the operation and expansion of this type of development.



Figures 08 and 09. Lack of space and lighting in the cooperatives of Campina Grande.

Source: the authors

5. FINAL CONSIDERATIONS

Solid waste is currently a problem that significantly affects the sustainability of the planet. The National Solid Waste Policy indicates mechanisms and forms of solid waste management in Brazil, constituting an advance to improve this problem. However, it is worth mentioning that the main concern in terms of management should be the reduction in the generation of waste currently produced and then the forms of reuse and recycling with

their revaluation; composting processes and biological cycles for some materials; and finally, the adequate allocation of those that can not be revalued and introduced into new productive cycles.

The cooperatives that act in the collection and recycling of materials (solid waste) give their contributions, providing a revaluation of these materials that will re-enter new productive cycles and, thus, reducing the amount of waste and the impacts on the environment. Recognizing the importance of the work of these workers for solid waste management at the municipal level, the motivation for carrying out the present study was to know the risks, due to the direct contact with several residues in the work environment that can compromise the quality of life and the health of workers.

In this sense, the objective of the study was to evaluate the physical, biological, chemical, ergonomic and labor accident risks of workers in the recycling cooperatives that are registered or linked to the City Hall of Campina Grande, PB. By identifying the existence of different risks in the work done by the collectors next to the sorting process and the way of storing the materials of commercial interest, we come to some findings.

Regarding the physical risks, it was verified that, due to the electric press, the noises are present with high intensity in three cooperatives, and it was also verified the vibrations and the heat present in the process of compaction of the materials. As to chemical risks, the main aspect was the presence of dust, depending on the amount of cardboard and paper in the working environment. However, in relation to contact with gases, vapors, composite substances and chemicals, two cooperatives stated that they did not receive any type of container already used for the storage of chemical products or compounds, and therefore did not expose workers to such risks. The other cooperatives present medium intensity of risks (gases, composite substances and chemical products), since some containers with chemical residues come together with other materials collected. Biological risks (Bacteria, Bacilli, Fungi, Protozoan, Parasites and Viruses) are present in all cooperatives, and in three there was high intensity and one there was medium intensity, having as main factor some hospital waste that reaches the cooperatives. Regarding the ergonomic risks, it was verified that in all the cooperatives there is intense physical effort, weight transport, inadequate posture and repetitiveness; in two cooperatives it was found that in some moments there is excessive work rate, especially when the quantity of materials increases. On the other hand, the risks of work-related accidents are present in the environment of all cooperatives, highlighting the inadequate physical arrangement, the lack of CPE in most



cooperatives, the use of improvised tools, poor lighting, fire risks due to the presence of flammable material and improper storage of materials.

Thus, in addition to the inappropriate techniques used by recyclable waste pickers, the precariousness of the work environment and the absence of protective equipment also add negatively to the operational risks inherent in the processing and storage of these materials. All these aspects potentiate the possibility of accidents that can compromise the health and productivity of the group of workers of the cooperatives studied.

In this sense, the construction of the risk map made it possible to organize information on the types of risks to which the people working with the collection are exposed, as well as the diagnosis of biosafety in these environments, and it is indispensable to carry out measures that reduce or eliminate the risks in the workplace. Thus, the risk map is important to inform professionals about the risks in their work environment; however, it does not prevent possible accidents from occurring, and it is important to dedicate practices of prevention and control of occupational risks, whose performance may also reflect in improvements in the environment and valorization of the worker.

Regarding the reality of the collectors' life, it is confirmed that cooperativism in the segment of work and services is one of the administrative opportunities that could be analyzed and evaluated more seriously, because it represents a new working relationship that presents important and relevant advantages for all those involved in this system. Through the creation of cooperative systems or associations, with the support of private initiative and in partnership with public agencies, infinities of projects can be built, developed and executed, creating changes in the organizations of the collectors communities, allowing a better inclusion in society.

It is worth noting that the activity of the garbage collection is already recognized by the Ministry of Labor. Therefore, the creation and strengthening of cooperatives is the result of a reflection on the form of group work which, in turn, can promote the valorization of democratic principles, the participation of people in citizenship in a more autonomous way that can, therefore, generate social inclusion of collectors. This process of social inclusion depends, initially, on the implementation of actions that minimize the risks to health in the work environment with the support of the municipal government, since this is the role applicable to municipalities when it comes to the destination of urban solid waste, as provided by the National Solid Waste Policy.

However, conducting and publishing more research involving the collectors' work activities is essential to increase community awareness of the importance of the activity; as well as to act as guiding public policies aimed at improving the working conditions of these workers as effective agents for improving the quality of the environment.

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Received: 04 fev. 2018

Approved: 16 Apr. 2018

DOI: 10.20985/1980-5160.2018.v13n2.1385

How to cite: Souza, J. A.; Martins, M. F. (2018), “Map of risks in cooperatives of collectors of recyclable materials in the Municipality of Campina Grande-PB”, *Sistemas & Gestão*, Vol. 13, No. 2, pp. 232-245, available from: <http://www.revistasg.uff.br/index.php/sg/article/view/1385> (access day month year).