Tropentag 2020
Conference on International Research on Food Security, Natural Resource
Management and Rural Development
Organised by the Humboldt-Universität zu Berlin and the Leibniz Centre for Agricultural Landscape Research (ZALF)

THE USE OF AGROCHEMICALS AND MORTALITY BY STOMACH CANCER IN BRAZIL BETWEEN 1979 AND 2015

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Abstract
The intensive use of agrochemicals in Brazilian agriculture, typical of the productivist production model and based on commodities for export, has been correlated to several environmental problems and to human health, among them stomach cancer. This study seeks to analyze the correlation between the use of pesticides per area harvested from the three main crops of the country (soybean, corn and sugarcane), which together correspond to more than 70% of the planted area of the Brazil, and the annual mortality of stomach cancer. Through statistical analyzes in an ecological study, with a qualitative and quantitative approach, from the data from 1979 to 2015, the correlation of the variables is inferred and the need for public policies that allow to make food sovereignty feasible, in order to allow the production of food that takes into account the respect for nature and for human life. The Brazilian dependence on pesticide use itself as an obstacle to the exercise of food security and sovereignty, curbing industrialization, and imposing the subordination of the State to the power of multinationals. The use of pesticides in sugarcane, soybeans, and corn increased from 100,476,688.32 liters per harvested area in 1979 to 535,177,688.55 in 2015, while mortality from stomach cancer in Brazil increased from 8,602 cases to 14,265 in the same period. By correlating these data, this study concluded that the variables have a strong positive correlation. Consequently, the use of pesticides can be considered a risk factor for stomach cancer, setting up further evidence that the super dependent chemical production model needs to be rethought. For this reason, the pesticide needs to stop being just part of an (Agri)business to be analyzed under the focus that led to its use: healthily maintaining life. Therefore, the government needs to develop public policies that guarantee constitutional rights to an ecologically balanced environment and the health and life of society. However, what has been verified in recent years, mainly in the Jair Bolsonaro government, is an increase in the use of pesticides in the country and in the quantity of authorized substances, totaling 475 in 2019 and 150 until May 2020.

Keywords: Agrochemicals. Stomach Neoplasms. Commoditization. Food sovereignty.

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Introduction

Brazil stands out for its intense agricultural activity, given that it concentrates 22% of the world's agricultural areas (Rodrigues, 2006), routinely configuring it in the list of those that most export products from this sector (MAPA, 2017). To maintain productivity and the large numbers of exports, agribusiness members specialize in the production of commodities and the intensive use of pesticides. With the implementation of policies arising from the green revolution, the use of pesticides was imposed, together with the use of transgenics, which, in one cycle, culminated in an increase in "pests" for crops, which resulted in more pesticides, a fact still collaborating with credit policies that require its use for risk reduction (Pignati et *al*., 2017). Thus, this article aims to discuss the use of pesticides as a public health issue, in addition to the economic issues that always guide it, because of the need to build a political agenda that promotes food sovereignty. Therefore, it is assumed that the use of pesticides is directly related to the number of stomach cancer in Brazil. Several diseases, including cancer, are commonly associated with the use of pesticides (Carson, 2010; Carneiro et *al*., 2015), with stomach cancer standing out for the high number of deaths it causes (Blair et *al*., 1992).

Methodology

The study carried out adopted an ecological type epidemiological perspective, carried out through the correlation between environmental indicators (harvested area and use of pesticides) and a health indicator (mortality from cancer), considering human exposure to pesticides and the consequent occupational contamination, environmental and food as a probable cause of damage to human health. To carry out the research, a mixed approach was adopted, with qualitative analysis, based on quantitative analyzes. The hypothesis to be tested is whether there is a correlation between the use of pesticides and mortality from stomach cancer. The data of area harvested from crops (permanent and temporary), between 1979 and 2015, in hectares, were obtained through Municipal Agricultural Production (PAM) of the System of the Brazilian Institute of Geography and Statistics (IBGE-SIDRA). The three varieties of crops selected from the sixty-six available in the database were not chosen at random, but because the cultivation of soy, corn and sugar cane, together, accounted, in 2015, for 76% of all the planted area of Brazil, corresponding to 82% of all pesticide consumption (Pignati et *al*., 2017). To estimate the use of pesticides, the methodology developed by Pignati et *al*. (2014), who calculated the average amount of pesticides used per hectare for the three crops under analysis. Then, the number of pesticides from the three types of crops was added, totaling the use of pesticides per year. Stomach cancer mortality data, which receives the International Classification of Diseases (ICD-10), registered under code C-16, were obtained through the online Cancer Mortality Atlas of the National Cancer Institute (INCA), considering the national cases between the years 1979 and 2015. Among the types of cancer, stomach cancer is commonly pointed out in the literature as strongly related to the use of pesticides (Blair et *al*., 1992; Acquavella et *al*., 1998; Carneiro et *al*., 2015) and, therefore, it was the dependent variable chosen to perform the correlation. After data collection, descriptive data analysis was performed. Then, correlation and regression were tested. For all statistical analyzes (descriptive analysis, Spearman correlation, regression, and Durbin-Watson test) the SPSS Statistics software, version 20, was used.

Results and Discussion

This article is based on a time series analysis of the use of pesticides, based on the harvested area of soy, corn, and sugar cane, and of mortality from stomach cancer in Brazil, between 1979 and 2015. The annual data on the area harvested in hectares were obtained from IBGE-SIDRA (2017). Then, the average use of pesticides by Pignati et al (2014), in liters per hectare, was used for the three selected crops, adding, in the end, the quantities (Table 1). This research, through the analysis of the data on the use of pesticides per harvested area of soybeans, corn and sugarcane, together with the data on death from stomach cancer, revealed that the variables have a strong

positive correlation (r2 = 0.934), that is, the use of pesticides was a probable factor that contributed to the increase in the number of stomach cancer in Brazil during the last decades, configuring yet another evidence that the super dependent chemical production model needs to be rethought (Fig. 1). For this reason, pesticides need to stop being just part of an (agro) business to be analyzed under the focus that led to its use: maintaining life in a healthy way. Therefore, States need to build public policies that guarantee constitutional rights to an ecologically balanced environment and to the health and life of society.

Table 1: Calculation for the use of pesticides based on the harvested area of soy, corn and sugarcane in Brazil in liters (2015)

Agricultural crop	Harvested Area (hectares)	Average use of pesticides (liters/hectare)	Use of pesticides (liters)
Sugar cane	10,111,376	4.84	48,939,059.84
Corn	15,406,010	6.14	94,592,901.40
Soybean	32,181,243	12.17	391,645,727.31
TOTAL	57,698,629	-	535,177,688.55

Source: Elaborated by the authors, based on the databases IBGE-SIDRA (2017), INCA (2016) and methodology of Pingati *et al.* (2014).

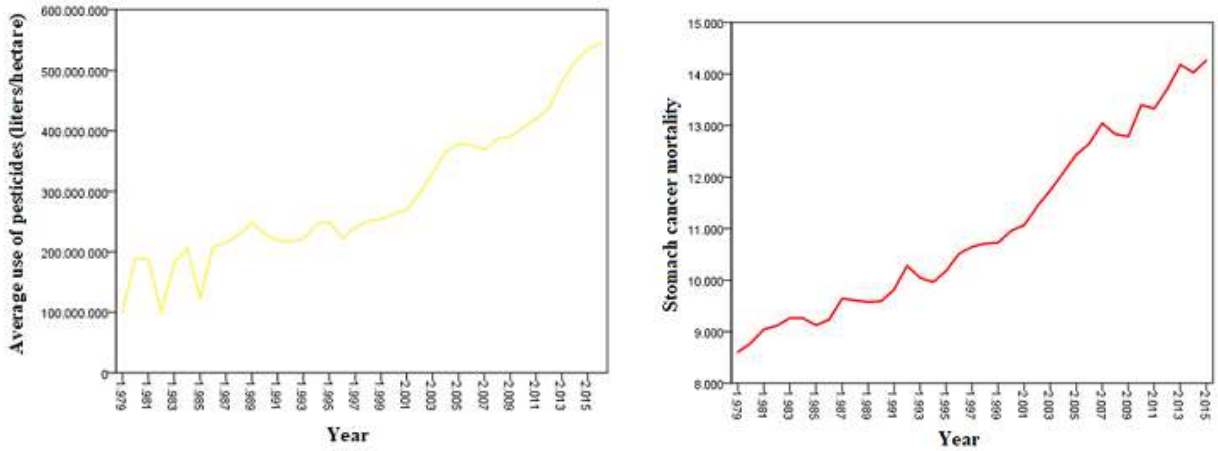

Figure 1: Use of pesticides in Brazil, based on the area harvested from soybeans, corn and sugarcane between 1979 and 2015 and death from stomach cancer in Brazil between 1979 and 2015.

The correlation between the use of pesticides and cancer cases is frequent in the literature. Blair et al. (1992) and Acquavella et *al*. (1998), when performing meta-analyses on the relationship between pesticides and cancer, observed a significant increase in cancers of the stomach, skin, prostate, brain, Hodgkin, myeloma and leukemia. In a bibliographic review of 83cohort and case-control studies, Bassil et *al*. (2007), point to associations between non-Hodgkin lymphoma cancers and leukemia and exposure to pesticides, especially for pregnant women and children, with the most consistent data being those associated with cases of brain and prostate cancer. Cunha (2010), analyzing the use of pesticides by region and age in Mato Grosso, inferred an association between high and medium levels of use and mortality from esophageal, stomach, pancreas, brain, prostate, leukemia and lymphoma neoplasms for the above age groups. Pignati et *al*. (2017), in an ecological study from the different regions of the state of Mato Grosso, correlate the environmental indicator (use of pesticides) with health indicators (acute intoxications, the incidence of fetal malformation and mortality from childhood cancer), in order to infer the existence of a positive correlation, and the values are more significant in regions of greater agricultural production.

Final Considerations

This research does not intend to close the subject, but, on the contrary, it is expected that the results will contribute to reinforce the need to carry out public policy planning for (un)use of pesticides, in addition to providing subsidies for new research. That corroborates the need to think about food sovereignty, promoting practices that are less aggressive to man and nature.

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