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Uses and Implications of Pesticides for Environmental Health and Family Farmers in the Hinterland of Paraíba

Usos e Implicações de Agrotóxicos à Saúde Ambiental e aos Agricultores Familiares do Sertão da Paraíba

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Abstract

Pesticides have caused countless impacts on the environment, the food production, and human health. This study aims to understand the environmental perception of farmers in the hinterland of Paraíba, Brazil, about the uses and impacts of pesticides in regional family farming. For data collection, questionnaires were applied to family farmers containing 11 questions/statements distributed in discursive questions (seven) and questions in the Likert scale (four). The sample comprised 148 participants distributed in the municipalities of Santa Luzia (62), São José do Sabugi (27), Várzea (22), Mãe D'Água (20), and Imaculada (17). Among them, 87.2% (n = 129) said they had already used agrochemicals in agriculture to prevent pests, insects, and bacteria. Family farmers reported using 12 types of pesticides. Some of them were of toxicological classifications III and IV; exposure to pesticides may cause serious damage to the environment and to health. Participants obtained information on the use and application of these pesticides through neighbors (37.8%, n = 56), family members (33.8%, n = 50), and the media (28.4%, n = 42), and 33.1% of farmers said they discarded empty pesticide containers in the trash. The farmers evaluated the need for guidance and/or technical training for their protection and better choice and handling of these agrochemicals, or other ways to conduct a more sustainable and healthy management. It is necessary to awaken a systemic relationship between man and the environment capable of promoting awareness of rural residents about the use of agroecological practices seeking sustainable agriculture.

Keywords: Human Health. Environment. Agroecological Practices. Sustainable Agriculture.

Resumo

Os agrotóxicos têm causado incontáveis impactos ao meio ambiente, a produção de alimentos e a saúde humana. Este estudo objetivou conhecer a percepção ambiental de agricultores do sertão da Paraíba, sobre os usos e impactos da utilização de agrotóxicos na agricultura familiar da região. Para a coleta de dados, foram aplicados questionários a agricultores familiares com 11 questões/afirmativas, distribuídas em discursivas (7) e objetivas na escala de Likert (4). Foram entrevistados 148 participantes, distribuídos nos municípios de Santa Luzia (62), São José do Sabugi (27), Várzea (22), Mãe D'Água (20), e Imaculada (17). Grande parte dos agricultores (87,2%, n = 129) já utilizou os agroquímicos na agricultura para prevenir pragas, insetos e bactérias. Os agricultores familiares identificaram 12 tipos de agrotóxicos usados no sertão paraibano, na qual se percebe que os trabalhadores se expuseram às substâncias que podem provocar sérios prejuízos ao meio ambiente e à sua saúde humana. Os agricultores afirmaram que obtiveram informação do uso e aplicação de agrotóxicos por meio de vizinhos (37,8%, n = 56), familiares (33,8%, n = 50) e meios de comunicação (28,4%, n = 42). 33,1% dos agricultores afirmou descartar no lixo as embalagens vazias de agrotóxicos. É necessário despertar uma relação sistêmica entre o homem e meio ambiente, capaz de promover a sensibilização dos moradores rurais para uso de práticas agroecológicas, em busca de uma agricultura sustentável.

Palavras-chave: *Saúde Humana. Meio Ambiente. Práticas agroecológicas. Agricultura Sustentável.*

1 Introduction

The excessive use of pesticides in industrial agriculture is a strategy to maintain a high productivity. The constant use of pesticides causes serious damage to the health of the population and the environment (MELLER; COSTA; CEOLIN, 2021; SANTANA *et al*., 2016). The Brazilian agricultural model fits predominantly into these industrial standards. It is strongly associated with the use of pesticides in its agricultural practice, in which, often, the environmental and social impacts are neglected (FERREIRA, 2015; MONTEIRO *et al.*, 2021).

Pesticides are low molecular weight synthetic organic compounds used to prevent and control pests in crops. However, due to their toxicity and biocidal action, the use of most pesticides is associated with major risks and impacts to human health and the environment (VIERO *et al*., 2016).

Until today, Brazil still has public policies that encourage the use and marketing of pesticides (FREITAS; BOMBARDI, 2018; LOPES; ALBUQUERQUE, 2018), being one of the world leaders in agrochemical consumption (OLIVEIRA et al., 2018). It is one of the countries that use these chemical inputs intensively on a large scale (VECHIA *et al.,* 2016).

The State of Paraíba surpasses the national percentage in the constant use of pesticides. The purchase and consumption of agrochemicals are intense. In this scenario, it is important to warn of the devastating effects that the excessive use of pesticides may cause to farmers, as they may damage the

health of the producer, the environment, and the society that consumes the products of these crops (SANTOS; OLIVEIRA, 2015).

The problems caused by the harmful effects of pesticides on health permeate the entire family nucleus (SANTOS, 2014; SANTOS; OLIVEIRA, 2015). However, the most vulnerable demographic to poisoning are rural workers, followed by children, the elderly, and people with health problems in general (CASSAL *et al*., 2014).

Intoxication occurs due to lack of information, communication, and adequate technical assistance to family farmers, which is related to the lack of use of Personal Protective Equipment (PPE), the lack of care in handling, and the ease of access to the chemical compound without a proper orientation for use (RANGEL; ROSA; SARCINELLI, 2011).

The application of pesticides in crops may contaminate the soil and water resources and generate consequences ranging from environmental degradation and damage to human and animal health, significantly altering ecosystems (CARNEIRO *et al*., 2015).

The effects of pesticides on human health are classified as acute, resulting from exposure to high concentrations in a short period, and chronic, resulting from exposure to small concentrations for a prolonged period (RÓDIO; ROSSET; BRANDALIZE, 2021). Some of the acute effects are: skin and eye irritations, headaches, dizziness and nausea. Chronic effects involve the development of asthma, diabetes, cancer (KIM; KABIR; JAHAN, 2017), congenital malformations and endocrine, neurological and mental disorders (CARNEIRO *et al*., 2015).

Environmental degradation has long-term consequences, and its effects can be irreversible (SANTOS *et al.*, 2021; WACHEKOWSKI *et al.*, 2021). Thus, when considering the negative impacts of conventional agriculture triggered by the use of pesticides, it is necessary to adopt alternative production techniques, such as those based on agroecological practices, as Agroecology can promote a methodology and the knowledge necessary to develop a highly productive, and environmentally sound, sustainable and economically viable agriculture (GLIESSMAN; ROSEMEYER, 2009).

Due to the indiscriminate use of pesticides and their impacts on the environment and health, especially rural producers, different studies have been conducted to investigate farmers' environmental perceptions of the use and effects of these compounds (AMARO *et al*., 2021; SALVADOR-SHIINOKI; DINIZ; ALVES, 2020; SIMONATO *et al*., 2020; SOUSA *et al*., 2018; WAHLBRINCK; BICA; REMPEL, 2017).

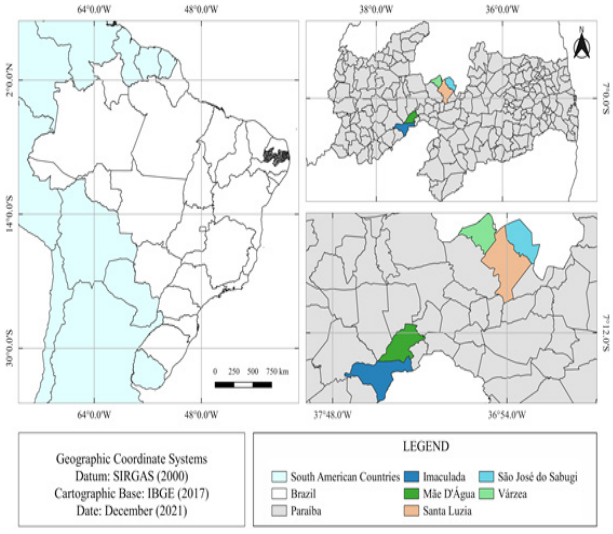
This study aims to understand the environmental perception of farmers in the hinterland of Paraíba, Brazil, about the uses and impacts of pesticides in regional family farming.

2 Material and Methods

2.1 Study areas, population, and sample

Field research was carried out in family farming properties located in rural communities in municipalities of Paraíba, Brazil: Santa Luzia, São José do Sabugi, Várzea, Mãe D'água, and Imaculada (Figure 1). The choice of cities was intentional and considered the predominance of rural family work with the cultivation of plants and animal husbandry (swine, cattle, poultry).

Figure 1 - Map of Brazil and Paraíba locating the municipalities where family farmers participated in the research



Source: Research data.

The municipality of Santa Luzia has the largest population estimated at 15,336 inhabitants, while the municipalities of São José do Sabugi, Várzea, Mãe D'água, and Imaculada have, respectively, 4,141, 2,810, 4,009, and 11,819 inhabitants (IBGE, 2018).

148 family farmers from the interior of Paraíba participated in the research. Of this total, 62 were rural workers in the municipality of Santa Luzia, 27 resided in Várzea, 22 resided in São José do Sabugi, 20 resided in the municipality of Mãe D'Água, and 17 resided in Imaculada.

The municipalities mentioned are included in the geographic area of coverage of the Brazilian semiarid region, which has long periods of drought and a hot weather (ALVES *et al.,* 2011). The communities described in Paraíba are in the Caatinga Biome and have a vegetation composed of xerophilic plants adapted to the dry climate of the semiarid region.

2.2 Methodological procedures

This study was carried out in the second half of 2019. The method was targeted visits to rural properties aiming to collect specific information on the topic addressed, that is, related to the way the rural producer acquires and uses pesticides in the development of rural activities and how it affects health, way of life, and the environment.

Data collection took place through a questionnaire (Table

1), containing seven subjective questions and four statements structured according to the Likert scale, with five levels of answers (level 1 - completely disagree to level 5 - completely agree).

Table 1 - Questions and statements in Likert applied to family farmers in the municipality of Santa Luzia, Paraíba, Brazil, regarding pesticides

	Open questions
01	In your perception, why are pesticides used in agricultural production?
02	Do you and/or have you used pesticides? If yes, state the name of the pesticide used and for what purpose.
03	Have you had access to any information about the use and application of pesticides? If so, how did this access happen and what information was obtained?
04	How do you dispose of the pesticide containers you use?
05	Do you believe that during the application of some type of pesticide there may be a risk of death for those who apply it or who are close to the application site? Why?
06	Do you know what agroecology is?
07	In your daily life, do you usually consume the food you produce with the use of pesticides? Do you believe that these foods can pose some risk to your health?
	Affirmations in Likert
08	I use PPE's during the application of pesticides in the field (Personal Protective Equipment).
09	The use of pesticides can contaminate the water that supplies my community.
10	Inappropriately discarded pesticide containers can cause environmental contamination.
11	I believe that it is possible, considering my reality, to produce food sustainably without using pesticides.

Source: Research data.

The approach for collecting data from residents consisted of a brief personal presentation of the researcher, followed by the survey and the purpose of the questionnaire, thus clarifying the objective of the study. Residents formalized their acceptance of participation in the research by signing an informed consent; one copy was delivered to the informant and the other to the researcher. This research was approved by the Research Ethics Committee of Faculdades Integradas de Patos (CEP/FIP) under protocol CAAE no. 82671618.3.0000.5181.

The inclusion criteria in the research were 1) be a family farmer able to understand and answer the study questionnaire; 2) residing in the place for more than 15 years; 3) be between 25 and 65 years old and active (not retired); 4) be a member of different families considering the first degree of kinship.

2.3 Data analysis

Data collection took place quantitatively and qualitatively through descriptive statistics using the *software* Microsoft Excel 2016. The percentage frequencies of answer alternatives were used. The level of knowledge of family farmers about the use of pesticides was analyzed.

The information collected was systematized and then analyzed considering theoretical supports of the current literature, which contributed to understand the perception of family farmers in the countryside of Paraíba.

3 Results and Discussion

Among the family farmers who participated in the survey, 45.9% (n = 68) were female and 54.1% (n = 80) were male aged 28 to 54 years. Of these, 65.5% (n = 97) had lived in the rural area for more than 30 years.

Most farmers were aged between 41 and 50 years (73.0%) and were male. Silva *et al*. (2014) reported similar data in five rural communities in the municipality of Pombal, Paraíba, in which 61.0% of family farmers are male and over 41 years old. Silva *et al*. (2017) studied the Dona Antônia and Gurugi II settlements in the municipality of Conde, Paraíba, and also reported a predominance of family farmers between 41 and 50 years of age.

For most farmers, pesticides are chemical products used in farming (52.0%, n = 77) to prevent pests, insects, and bacteria, and most residents (87.2%, n = 129) stated that they have already used agrochemicals in agriculture; they also reported using various types of pesticides in their plantations (Table 2).

Table 2 - Pesticides used by family farmers participating in the research and residing in the countryside of Paraíba

Substance	**Main use**	**Toxicological classification toxicológica (ANVISA*)**	**Quantity of Citation**
Sulfluramide	Inseticide	Class IV	22
Metomil	Inseticide	Class I	19
2, 4 – D	Herbicide	Class I	17
Acephate	Inseticide	Class III	14
Glyphosate	Herbicide	Class IV	13
Fipronil	Inseticide	Class II	11
Diuron	Herbicide	Class III	9
Chlorpyrifos	Inseticide	Class II	7
Diazinone	Inseticide	Class II	7
Mancozeb	Fungicide	Class III	5
Atrazine	Herbicide	Class III	4
Malationa	Inseticida	Class III	1

* ANVISA: National Health Surveillance Agency
Source: *ANVISA, 2016.*

Twelve types of pesticides used by family farmers in the countryside of Paraíba were identified. Some pesticides described in the research belong to toxicological classes I and II. According to Sena, Dourado and Antoniolli (2018), they are extremely toxic and highly toxic, respectively. Considering this classification, workers were exposed to substances that can cause serious damage to the environment and health.

The National Health Surveillance Agency *(*ANVISA) has carried out the toxicological re-evaluation of several pesticides, including 2,4-D and Glyphosate, already used by farmers. The reassessment takes place because its records are old and when verified, the scientific methodologies were little

advanced (ANVISA, 2016). However, according to Costa, Mello and Friedrich (2017, p. 61), "the overlapping of the interests of the agricultural sector in relation to the protection of human life prolongs the permanence time of these products in the national market."

In addition, new pesticides often appear in the market without precise studies on the chronic damage related to their use. Thus, the family farmer, in his practice, is vulnerable to the toxic action of these chemical compounds (FERREIRA, 2015). Therefore, there is an intense national production and marketing of agrochemicals together with an intense use in the Brazil's farming areas, whether on small, medium or large rural properties, without preventive actions aiming the quality of life of the farmer who is in direct contact with the substance at the time of application.

In the international literature, published scientific research also highlights the impacts of pesticides on the environment and on the health of farmers. Rahman *et al*. (2021) researched the influence of pesticide use on the health of farmers residing in Salumbhu, Nepal, identifying that farmers who make direct use of these chemicals are more likely to develop health complications, with diverse symptoms and serious consequences.

Farmers stated they have already received information on the use and application of pesticides (Table 3). This information was obtained from neighbors (37.8%, n = 56) and family members (33.8%, n = 50), and the media (28.4%, n = 42). The information they obtained encouraged its use by rural residents.

Table 3 - Information obtained by family farmers in the countryside of Paraíba on the use and application of pesticides in agriculture.

Farmer	Answers
A2	Pesticides are important to help fight pests and to increase crop production.
A8	To keep bacteria and fungi away from crops.
A13	To eliminate some pests in bean crops.
A54	To eliminate insects that cause disease.

Source: Research data.

Family farmers claimed to dispose of empty pesticide containers incorrectly, throwing them in the trash (33.1%, n = 49), burning or burying (28.4%, n = 42), or washing and reusing (25.7%, n = 38). None of the participants reported the correct disposal practice, which would be the return of the empty package to the company that sold it or to accredited receiving stations.

Staudacher *et al.* (2020) in Costa Rica and Uganda, identified that a percentage of farmers participating in the survey, 14.0% and 19.0%, respectively, reported dumping pesticide residues directly into water bodies.

Although the survey participants reported receiving some type of guidance related to protection during the application of pesticides, PPE is only used by 17.6% of workers (Table 4). Among the reasons reported by farmers who do not use PPE is lack of knowledge about the risks to which they are exposed and the discomfort of the protective equipment, the region's climate, and reduced mobility, which make work more difficult and delay the completion of the work. Rural workers lack care for their health and basic information about the risks inherent to the use of pesticides.

Table 4 - Frequency (%) of responses related to pesticides from family farmers (n = 148) in the hinterland of Paraíba

Affirmations	DC	DP	IN	CP	CC
I use PPE's during the application of pesticides in the field (Personal Protective Equipment).	32.4	24.3	25.7	0.0	17.6
The use of pesticides can contaminate the water that supplies my community.	14.2	19.6	21.6	20.9	23.7
Inappropriately discarded pesticide containers can cause environmental contamination.	13.5	12.2	16.9	27.0	30.4
I believe that it is possible, considering my reality, to produce food sustainably without using pesticides.	12.8	14.2	17.6	18.9	36.5

Legend: Completely Disagree (DC); Partly Disagree (PD); Indifferent (IN); Partly Agree (CP); Completely Agree (CC).
Source: Research data.

Mehmood *et al.* (2021) stated that in Punjab in Pakistan, one of the most populous areas in the country and which has more than half of the population engaged in agricultural activities, the PPE's are mostly limited to hats (33.1%), masks and scarves nose protection (28.6%) and boots and socks (12.7%). However, other PPE's that provide greater safety to farmers are little used, exposing these farmers to toxic pollutants.

In the perception survey with farmers (n = 380) developed by Masruri *et al.* (2021) in Kashmar, Khorasan Razavi, Iran, it was identified that local farmers have vulnerabilities regarding the knowledge and proper technique for applying pesticides, noting that 44.2% never wear protective eyewear when applying pesticides, as well as 19.5% never wear gloves or long boots (42.9%), increasing the risks of contamination with handling and application pesticides.

In Meru, Kenya, in the research by Marete *et al.* (2021) with 173 families of farmers, concluded that 26.0% of farmers who volunteered to participate in the research said they felt some discomfort caused to their health after the application of pesticides, associated with this, it was found that most do not use PPE.

A large number of farmers reported that during the application of some type of pesticide there may be a risk of death (81.8%, n = 121), as agrochemicals have substances that can harm health (80.4%, n = 119). The current management

of pesticides, together with their incorrect consumption, is responsible for the contamination of air, water and food, which directly interferes with human health. In addition, the contamination of the environment is another consequence of the use of pesticides because of their dispersion in nature from wind and water.

A survey by Wahlbrinck, Bica and Rempel (2017) in the municipality of Imigrante, located in the region of Vale do Taquari, Rio Grande do Sul, Brazil, reported that 89.2% of farmers were aware of the risks that the use of pesticides may pose during application. Other studies also show that most farmers recognize that exposure to pesticides can harm human health (ALVES *et al*., 2013; PELAEZ *et al*., 2015).

According to Sena, Dourado and Antoniolli (2018), all family members participate in farming work in subsistence agriculture; therefore, the entire family is exposed to risks caused by the use of pesticides. Excessive consumption of pesticides is related to lack of knowledge, inadequate professional monitoring, or the lack of it.

The foods that are produced with the use of pesticides are consumed on a daily basis in farmers' homes (87.2%, n = 129). A good part of the workers also stated that some food produced is sold to the urban area (70.9%, n = 105).

Most participants (72.3%, n = 107) did not know about Agroecology, but considered (63.5%, n = 94) that it is possible to produce food sustainably without using pesticides. However, all of them develop small-scale agriculture considering the dominant agricultural pattern. They use agrochemicals as the only source of combating fungi, insects, and weeds.

From this perspective, it is important to highlight the need to acquire a production trend based on sustainability that inhibits the use of organic inputs in crops, which is necessary for the quality of life, environmental balance, and a break with the current pattern of development. Celestrino *et al*. (2017) states that this generation of values considers the concept of sustainable rural development.

Sustainable rural development can be articulated using the knowledge of Agroecology as a science (VIEIRA; BERNARDO; JUNQUEIRA, 2015). Agroecology is a science that promotes the production of food in an ecologically balanced way seeking to conserve biodiversity through ecological practices and the integrated management of natural resources and sustainability (CALDART, 2016; NODARI; GUERRA, 2015).

4 Conclusion

The family farmers surveyed use pesticides in their plantations, some of them with a high toxicological classification. Despite this, few farmers mention the use of PPE and there is incorrect disposal of the pesticides used. They do not know about Agroecology; however, they believe that it is possible to produce food in a healthier way, avoiding toxic components.

Thus, there is a need to disclose information about the use of pesticides, especially with regard to safety measures. In addition, municipal and regional policy actions aiming to improve knowledge and, consequently, awareness of the use of agroecological practices are essential. The objective is to achieve sustainable agriculture favorable to the environment, health, and an economically more productive market for family farmers.

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