



## Family farmer and (un)safe use of pesticides in Lavras, Minas Gerais, Brazil

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*O agricultor familiar e o uso (in)seguro de agrotóxicos no município de Lavras/MG*

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### Abstract

**Introduction:** the pesticides "safe use" paradigm relies on the hazard control measures concerning handling of these products. However, studies carried out in Brazil reveal a scenario of rural workers' exposure and health problems. **Objective:** to analyze the feasibility of pesticides "safe use" measures in the social and economic context of the family farmers from Lavras, Minas Gerais, Brazil. **Methods:** cross-sectional study with with 81 small family farms, in Lavras, Minas Gerais, Brazil, in 2013. **Results:** purchase, transportation and storage facilities do not meet the "safe use" requirements; there is technical unfeasibility to follow safety measures related to Personal Protective Equipment (PPE) as well as the rules concerning the preparation and application of pesticides; social and economic obstacles are the main reasons for not returning empty containers and for washing contaminated clothes and PPE at home. **Conclusion:** considering the general structure of family farms production, agrochemical technology cannot be employed under the "safe use" paradigm.

**Keywords:** pesticide; hazard; environmental health surveillance; rural population health; socioeconomic factors.

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## Introduction

As a result of the increasing cases of pesticide poisoning in developing countries and of the pressure exerted by non-governmental organizations and health agencies, such as World Health Organization (WHO), and environmental agencies, such as United Nations Environment Programme (UNEP), the Food and Agriculture Organization (FAO/UN) released, in 1986, the International Code of Conduct on Pesticide Management<sup>1</sup>. Its elaboration counted on the close involvement of the International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP), which is the chemical industries' organization responsible for ensuring the sector world interests. The code establishes conduct standards for trade as well as efficient and safe use of pesticides, drawing up guidelines for governments, industries, employers, and rural workers. In short, the code ensures pesticides are safe when correctly used<sup>2,3</sup>.

In the early 1990s, based on this conduct code, GIFAP (then renamed as Global Crop Protection Federation – GCPF – and currently as CropLife International) released the Safe Use of Pesticides Campaign, which had a pilot project developed in Guatemala, Kenya, and Thailand. Although GCPF disclosed overrated results based on fallacious data, the debates and public actions aimed at populations exposed to pesticides hazards and damages in developing countries have focused on the “safe use” strategies<sup>2</sup>.

Since 1989, Brazilian laws, decrees and regulations ruling production, marketing, supervision, and use of pesticides<sup>4-6</sup> have incorporated the guidelines of the International Code of Conduct on Pesticide Management<sup>1</sup> as a conceptual base and have followed the “safe use” as a paradigm for human health and environment protection<sup>7</sup>. Despite disregarding the incentive to agro-ecological food production and to the development of alternative technologies for production preservation, this regulatory framework excludes 12.3 million “self-employed” family farmers. This category corresponds to 84.4% of the Country farms, employing 74% of the rural work force, and providing 70% of the food consumed by Brazilians<sup>8</sup>. These farmers have easy access to pesticides, but they do not count on control means and inspections that guarantee the recommended “safe use”.

The State and industrial stimulus to the intensive use of pesticides, associated with public policies for health, environment and labor based on the “safe use” paradigm, have been shown the increasing

cases of acute<sup>9-18</sup> and chronic<sup>19-21</sup> intoxications, especially among family farmers.

However, studies conducted in several Brazilian rural regions<sup>22</sup> do not present data on all work activities involving pesticides exposure and contamination. Similarly, if the wide range of measures described in safety manuals is considered, we observe that the analyses of “safe use” within each of these activities have been carried out in a limited way<sup>22</sup>.

The fragmented and non-comprehensive pesticides “safe use” approach may be limited to show the inadequacy of this paradigm under the socioeconomic family farming context. To reveal the health and environmental consequences of its adoption under the legal framework and public policies for family farming, this study aims to identify the practices of pesticide use in the activities of purchasing, transporting, storing, preparing and applying, disposal of empty packages, and washing of contaminated clothes and equipment.

## Methods

Cross-sectional study conducted in 2013 in the 19 rural communities of Lavras, Minas Gerais, where approximately 5% of its 92,200 inhabitants lived<sup>23</sup>. Such communities are settlements historically established and spatially distributed in the rural surroundings of Lavras. It is through them that the local government organizes, controls and provides public services, such as agricultural technical assistance, road repairs, and the Family Health Strategy (ESF).

The family farmers who took part in this study would be initially chosen through the family farmers registration that the State Technical Assistance and Rural Extension Agency (Emater) claimed to provide. However, we identified that this “register” was a nominal list of family farmers who had once sought care at this institution. Their names were not grouped by “family”, “property”, “community”, or any other designation. This list had 1,613 names (including, for example, more than one member of the same family, people who have left the countryside, and even deceased ones) and their respective personal identification number. However, local administration institutions estimate there are around 600 family farms in Lavras.

The solution to define in a more accurate way the population to be studied, and the farmers' families distribution among the communities, were the lists of family farms followed by the Rural Community Health Agents and by two Primary Health Units

(UBS) that provide services to the rural communities. As these lists do not distinguish between family farmers and middle or large farmers, we crossed the list names with those of the Emater family farmers. Thus, we identified 440 family farms distributed by the 19 rural communities. This number was set as the study target population, which was distributed over four areas:

- North: Funil and Paiol communities (18% of family farms);
- South: Serrinha, Cachoeirinha, Tomba, Faria, and Ponte Alta communities (19%);
- East: Fonseca, Tabuões, and Itirapuã communities (12%);
- West: Queixada, Engenho de Serra, Pimentas, Maranhão, Rosas, Três Barras, Salto das Três Barras, Cajuru, and Boa Vista communities (51%).

To obtain the sample size, we used sample calculation for proportions, considering the following parameters: 5% significance level, 10% sampling error, and prevalence of 0.50. Thus, from the total of 440 family farms, 81 were sampled<sup>24</sup>. Using sampling error of 5% would result in a sample size of nearly 50% of the farms. Because this is a descriptive and not an analytical study, we chose to accept a greater error (10%) and obtain a feasible sample size. The 81 units were proportionally distributed according to the number of family farms in each of the four rural regions.

To select interviewees, we list the names of each community in alphabetical order. Then, we merge the community lists from the same region, and put the resulting list in alphabetical order. In the North, for example, the first 39 names on the list referred to the Funil community family farms representatives in alphabetical order, and the next 40 names referred to the Paiol community family representatives also in alphabetical order. So, by ordering all 79 names alphabetically, we created a random list of the region, “shuffling” the family farms from Funil and Paiol communities. The same was done for the other rural areas.

After that, we presented the list of each region to the UBS and rural Community Health Agents. They identified the family farms that “certainly” or “probably” used pesticides and those that “certainly” did not use. After this filter, a new list was produced, keeping the order already mentioned, consisting only of farmers who “certainly” or “probably” made use of pesticides. Considering the size of the post-filter list and the number of interviews required in

each region, we raffled the families that would be interviewed and those that would be “substitutes” in case these were not available for the interviews. So, we obtained a systematic random sample.

For data collection, we constructed a semi-structured questionnaire containing two axes: socioeconomic characterization and work practices related to the use of pesticides. The questions were formulated accordingly to publications of the Brazilian association of chemical industries (ANDEF)<sup>25-30</sup>, as well as of the Brazilian sanitary surveillance agency (Anvisa)<sup>31</sup>, the Brazilian corporation of agricultural research (Embrapa)<sup>32</sup>, and of the Fundacentro, a safety and health foundation of the Ministry of Labor and Employment<sup>33</sup>. We interviewed farmers aged over 18 years that were working in the family farm, even if not exclusively. We adopted the definition of family farming as described in Law no. 11,326/2006<sup>34</sup>.

For the farmers’ socioeconomic characterization, we interviewed those in charge of the farms (owners or any other family member who had the same level of responsibility and decision regarding production). To collect data related to pesticides working practices, we interviewed the workers who were engaged in activities involving direct pesticide exposure, such as handling pesticides, adjuvants, and related products, in any of the following activities: purchasing, transporting, storing, mixing and applying, final destination (disposal) of empty containers, as well as washing of contaminated clothes and personal protective equipment (PPE). Both axis, “Socioeconomic characterization” and “Work practices related to the use of pesticides” were included in the questionnaires answered by the family farmers who were responsible for the farm and engaged in work activities involving direct exposure. If the selected farmers did not work in these activities, other family farm members were chosen for the interviews.

The following exclusion criteria were adopted in this study: family farms that did not use pesticides, and family farmers under-aged.

As the fieldwork was intensive, the interviews were divided in two stages, from July 15th to August 7th and from 10th to 12th December, 2013. The data collected were inserted into a database and analyzed by the EpiDataAnalysis software (version 2.2.2.182)<sup>35</sup>.

We made a descriptive analysis of the socioeconomic characteristics of family farmers, the characteristics of the farms, and of the pesticide use pattern. Then, we carried out the analysis of working practices related to the use of pesticides, identifying their consonance to the measures recommended by

the “safe use” of pesticides paradigm in the manuals used for the preparation of the questionnaire.

This study was approved by the Research Ethics Committee of Faculdade de Ciências Médicas da Universidade Estadual de Campinas (protocol number 313375, June 24th, 2013). We also obtained authorization from the Lavras Health Office to conduct the research.

## Results

We visited 81 farms and a total of 136 farmers were interviewed: 81 were in charge of the farms and other 55 handled pesticides. Only two out of the 81 farms refused to participate in the study and were replaced by the “alternates” which were previously picked for this purpose. The sample size estimated for the study was not reduced.

The visited farms had between 0.4 and 115.0 ha (mean 31.7 and median 24.0 ha). The work force (people who worked directly with pesticides or not) ranged between 1 and 12 workers per farm (**Table 1**).

According to what was reported in the interviews, the production of the family farms was diversified, with fruits (8.7%), vegetables (7.8%), tubers (3.2%), eucalyptus (0.9%), and beans (11.0%). The highlights, though, are coffee (18.3%), maize and sugarcane (27.4%), and dairy farming (22.8%). It is

important to note that the production of corn and sugarcane is mainly to the feeding of dairy cattle, not for household consumption or for marketing.

Regarding the average monthly household income, the families showed some homogeneity in the revenue in minimum wages (**Table 1**), and, in 84.0% of the farms, more than three people, reaching 16, depend on this income. Regarding schooling of those responsible for the farm, we identified 41 farmers (50.6%) with up to four years of formal study, 5 of them illiterate. By adding the 11 farmers with up to seven years of schooling, we have that 64.2% of those responsible for the family farms have not finished elementary school (**Table 1**).

In 55.6% of the farms, 2 to 5 pesticides were used, and in 35.8%, 6 to 20 different pesticides. Only in 8.6% of the family farms a single pesticide was used. (**Table 1**). This pesticide use pattern, with multi-chemical exposition, was focused on up to 2 workers in 69.1% of the family farms. Our analysis also found that the 81 farms used 127 different commercial pesticides, formulated from 88 active ingredients belonging to 54 different chemical groups. Of these 127 pesticides, 52 (40.9%) were classified in Brazil as Extremely Toxic (class I) and Highly Toxic (class II).

**Table 2** presents the data regarding working practices related to the use of pesticides among family farmers from Lavras.

**Table 1** Family farms socioeconomic characteristics. Lavras, MG, Brazil 2013.

<i>Characteristics</i>	<i>n=81</i>	<i>%</i>
Farm total area (hectares)		
from 0.1 to 30.0	47	58.0
from 30.1 to 60.0	23	28.4
from 60.1 to 120.0	11	13.6
Number of farmers/workers who handle pesticides		
1 to 2	56	69.1
3 to 4	23	28.4
5 to 6	2	2.5
Number of pesticides used		
1	7	8.6
2 a 5	45	55.6
6 a 20	29	35.8
Average monthly family income (in minimum wages)		
until 1.4	23	28.4
from 1.5 to 2.9	26	32.1
from 3.0 to 5.4	22	27.2
5.5 or more	10	12.4

(Continues)

**Table 1** Continuation...

<i>Characteristics</i>	<i>n=81</i>	<i>%</i>
Number of members that depends on the family income		
1 a 2	13	16.0
3 a 5	54	66.7
mais de 5	14	17.3
Age group of the farm responsible (years)		
27 to 39	20	24.7
40 to 49	23	28.4
50 to 59	21	25.9
60 or more	17	21.0
Schooling of the farm responsible (years)		
less than 5	41	50.6
from 5 to 7	11	13.6
from 8 to 10	15	18.5
11 or more	14	17.3

**Table 2** Family farms according to socioeconomic characteristics. Lavras, MG, Brazil 2013.

<i>Variable</i>	<i>n</i>	<i>Percentual</i>
<b>Acquisition</b>		
Agronomist consulted when the farmer buy pesticides	81	
Agricultural trade/ Cooperative/ Industry representative	48	59,3
Emater/ University/ Self-employed/ Relative/ Personal relation	10	12,3
Buy without consulting	18	22,2
Do not buy	5	6,2
Use agronomic prescription to buy pesticides	80 <sup>a</sup>	
Always	48	60,0
Sometimes	19	23,7
Never	13	16,3
Agronomist who provides an agronomic prescription	67 <sup>b</sup>	
Agricultural trade/ Cooperative/ Industry representative	62	92,6
Emater	4	6,0
Farmer is an agronomist and defines his own agronomic prescription	1	1,4
<b>Transportation</b>		
Vehicle used to transport pesticides to the farm	107 <sup>c</sup>	
Vehicle with dump body (pickup, truck, others)	32	29,9
Closed vehicle/ motorcycle	37	34,6
Bus/ van/ lift	16	14,9
Professional delivery	22	20,6
Always transport pesticides using vehicles with dump body, whether its own vehicle or from the company that sells them	81	
Yes	31	38,3
No	50	61,7

(Continues)

**Table 2** Continuation...

<i>Variable</i>	<i>n</i>	<i>Percentual</i>
Transport pesticides with other products	32 <sup>d</sup>	
Always	5	15,6
Sometimes	13	40,6
Never	14	43,8
Storage		
Place where pesticides are stored	81	
Only in an independent facility ("little houses", storehouses, barns, and garages)	72	88,9
Inside home/ Outdoors	6	7,4
Do not store it	3	3,7
The independent storage place follows the requirements: masonry; cemented floor or similar; without leaks; well-ventilated; well-illuminated	74 <sup>e</sup>	
Yes	31	41,9
No	43	58,1
Distance between the storage place (independent building) and any residence	74 <sup>e</sup>	
Less than 30 m	47	63,5
More than 30 m	27	36,5
<b>Preparation and application</b>		
During the preparation have you ever spilled or poured pesticide on yourself	81	
Yes	52	64,2
No	29	35,8
Use PPE mixing pesticides	81	
Always	46	56,8
Sometimes	16	19,8
Never	19	23,5
Use all PPE described in manuals mixing pesticides	46 <sup>f</sup>	
Yes	5	10,9
No	41	89,1
During the application, have your clothes ever got soaked or sprinkled by pesticides	81	
Yes	56	69,1
No	25	30,9
Use PPE applying pesticides	81	
Always	51	63,0
Sometimes	13	16,0
Never	17	21,0
Use all PPE described in manuals during the application	51 <sup>g</sup>	
Yes	6	11,8
No	45	88,2
Dress the PPE	6 <sup>h</sup>	
Correct order	0	0,0
Incorrect order / Without specific order	6	100,0
Undress the PPE	6 <sup>h</sup>	
Correct order	0	0,0
Incorrect order / Without specific order	6	100,0

(Continues)

**Table 2** Continuation...

<i>Variable</i>	<i>n</i>	<i>Percentual</i>
Know the meaning of re-entry Interval	81	
Yes	23	28,4
No	58	71,6
<i>Put a warning indicating the re-entry interval</i>	81	
Yes	2	2,5
No	78	96,3
N/A (applies only to cattle; no re-entry interval defined)	1	1,2
<b>Final destination of empty packages</b>		
How do you discard empty containers?	81	
Return to the seller	43	53,1
Burn it	37	45,7
Put away on common trash	1	1,2
<b>Washing of clothes/Contaminated PPE</b>		
Use apron to wash clothes/PPE contaminated by pesticides	81	
Yes	30	37,0
No	51	63,0
Use gloves to wash clothes/PPE contaminated by pesticides	81	
Yes	18	22,2
No	63	77,8
Is there an exclusive tank to wash clothes/PPE contaminated by pesticides?	81	
Yes	13	16,0
No	68	84,0
Where is drained the tank water after washing of clothes/ PPE contaminated by pesticides?	81	
Directly to the ground	60	74,1
Cesspool	12	14,8
Sewage	6	7,4
Septic cesspool	1	1,2
Water courses	1	1,2
N/A (claim not washing but burning clothes after the procedure)	1	1,2

<sup>a</sup> one interviewee said that he does not buy the pesticides used by him.

<sup>b</sup> refers to farmers that always or sometimes use agronomic prescription.

<sup>c</sup> more than one way of transportation was mentioned by some of the productive units.

<sup>d</sup> only farmers who transport pesticides with vehicles with dump body answered the question.

<sup>e</sup> only farmers who store pesticides in independent buildings away from residences.

<sup>f</sup> refers to farmers that always use PPE during the preparation.

<sup>g</sup> refers to farmers that always use PPE during the application.

<sup>h</sup> refers to farmers that use all parts of the PPE.

## Discussion

The excessive number of restrictions concerning “correct and safe” handling of pesticides evidences not only the high risks involved in their use, but also the inadequacy in prioritizing these risks control through the industrial “safe use” paradigm.

These evidences were the guide to carry out this research, which has shown to be able to apprehend the socioeconomic characteristics of family farmers and their practices regarding the complex security measures in purchasing, transportation, storage, preparation and application, final destination of empty packages, and washing of contaminated clothes and PPE.

### Purchase

The purchasing activity is one of the pillars of the pesticides “safe use” paradigm and it determines the potentiality of risk to the other activities. It is at the time of purchasing that one defines the toxicity of the pesticides to be transported, stored, mixed, and applied, and that will have their empty containers discarded, and contaminated clothes washed. In addition, according to safety manuals, the moment of purchasing is important to provide information and instructions on the procedures to be followed and precautions to be adopted in each of the activities involved in handling pesticides.

The manuals also emphasize that it is “essential to consult an agronomist so that crop problems are properly evaluated”. The agronomist is also responsible for issuing the agronomic prescription, needed for pesticide purchase<sup>25,30</sup>. Regarding these procedures, a conflict of interest was detected, since, according to the interviewees, the agronomist who was employee of the pesticide store is the same one that provides the prescription. (Table 2). The analysis of the agronomic prescription used by the 37 farmers who reported handling pesticides classified as Extremely or Highly Toxic, reveals that 29 of them (78.4%) received the prescription from agronomists employed by pesticide stores. So, the acquisition and handling of products with a higher risk of acute poisoning seems not being discouraged by these professionals and their prescriptions, on the contrary, it appears that it is directly influenced by the agronomists from the agricultural shops and cooperatives, probably through commercial practices involving pressure and incentive from the chemical industries through sales targets and bonuses.

Regarding the family farmers’ attitudes when purchasing pesticides, it is necessary to consider particularly the characteristics of their income and

schooling shown in Table 1. The family farmer inserted into the conventional production model that use pesticides, and in a context of limited household income, cannot be blamed for not “choosing” to hire a private agronomist for the evaluation of his crop and obtaining the agronomic prescription, as the agricultural stores offer this service “for free”.

### Transportation

The “safe use” manuals state that transportation of pesticides is unsafe if not in vans or trucks equipped accordingly to safety standards. However, the interviews revealed that not only vehicles were “inadequate”, but also the ways of transportation chosen (Table 2). In this context, family farmers cannot be held responsible for not having enough funds to buy a vehicle that would be considered suitable for “safe use” and by the fact that all purchases (including of small quantities) must be delivered in a professional way.

Another point emphasized by the manuals is that it is prohibited to transport pesticides side by side with other products, such as food, medicine, household items, feed, and grains. However, the exclusive transportation of pesticides in the bucket of a pickup truck is a “safe use” measure that is economically questionable. Family farmers have a limited income (Table 1). Living in the countryside, they have to waste working time and spend on fuel every time they go shopping, so they try to do several things at once. If they need to buy pesticides and any other product, probably they will not take two trips, one to transport the pesticides and another for the other products. In addition, they did not receive adequate support and instructions to do that.

### Storage

The “correct” storage of pesticides is an important safety measure to workers’ health and to the environment, but in general it was not observed in the simple structures and facilities of the farms visited, due to the context of misinformation and lack of institutional support for family farming in Lavras, Minas Gerais. Most family farmers mentioned that their farms did not have storage facilities that would meet the safety requirements (Table 2). From these data, we observed that, even when they report storing pesticides exclusively in premises separated from their houses, family farmers are not necessarily safe. It is important to point out that there are no local public programs aiming at financing the construction of suitable warehouses for pesticides storage. That is the reason why farmers keep using the already existing facilities in their farms, such as little houses, sheds, storages, barns, and garages,



where generally other utensils might also be kept. Besides, no public or private institution has supplied these farmers with information or training on the “safe” storage requirements and on the need of building proper places for storing pesticides.

Regarding the distance between the storage and the farmers’ homes, most farms are not in conformity with what was recommended in the “safe use” (Table 2). As shown in Table 1, most of the family farms in Lavras is smaller than 30 ha, being often infeasible for building a storage area located more than 30 meters far from their residences. As mentioned earlier, farmers store pesticides in structures already existing in their properties, no matter whether they are more than 30 meters far from their homes. Once again, it is not plausible to blame the farmers for not spontaneously building new structures located at a “safe” distance from their residences, as they keep their lives with limited income and information.

### **Preparing and applying pesticides**

Pesticides have the potential to poison the environment and the people as soon as they are removed from their container to be prepared and applied.

During preparation the risks of exposure and intoxication are higher, because the pesticide formulation is concentrated. Splashes on the body or inhalation can cause acute poisoning or contribute for long term injuries. Because there is not a “proper” place for the preparation of the pesticides to apply, they are diluted and mixed within the farming area and prepared directly in the sprayer, without the use of “correct” tools. Diluting pesticides using dirty water (taken to the farming area in barrels) are prevalent in the family farming context identified in Lavras. The 20 liter container, which is usually recommended for being proportionally cheaper, hinders the handling of the product as it might cause spill or splash. This was confirmed by most of the respondents who claimed they had already spilled or splashed pesticide on their body while preparing the pesticides. This fact became even more alarming when we observed that only five workers reported using all PPE described in the safety manuals as being indispensable for “adequate” health protection (Table 2).

The application of pesticides is another activity where we could identify that the “safe use” rules were inadequate for the real conditions, for instance: backpack sprayer (reported as the most used application equipment) provides direct contact with the worker’s unprotected body, providing inevitable contamination when a leak occurs; changes on weather conditions may result in economic loss, as

the pesticide application has to be postponed in rainy and windy days; when farmers applying pesticides have to walk on narrow lines between crops or inside the pens; and, above all, with the infeasibility of full use of PPE in open-air environments<sup>13</sup> and with the impossibility of following the complex rules, which are considered “correct” by the safety manuals, concerning dressing and undressing this equipment (Table 2).

The same context of low schooling and of infeasibility for working adopting numerous and complex safety measures probably leads to most respondents being unaware of the Restricted-Entry Interval, which might undermine the farm workers and their families’ health. The unawareness mentioned above causes family farmers to be unacquainted with the need of warning signs indicating the Restricted-Entry Interval period, when the area where plants were sprayed should be avoided without PPE (Table 2). However, even with such warnings, health is not completely protected, as the farmers’ houses are built very near the plantations, mainly in the smaller properties (Table 1).

### **Empty containers final destination**

The disposal of empty pesticide containers in the 81 farms visited in Lavras are not completely in accordance with the “safe use” measures described in safety manuals.

Little more than half of the interviewed farmers said that they always return the empty pesticides containers to the shops where they were purchased. In the 19 communities, or in their neighborhood, there is no (public or private) collecting of empty pesticide containers. Neither, shops, representatives, cooperatives, or local public institutions have programs for the active collecting of those containers. So, it becomes farmers’ responsibility to carry out this costly security measure, travelling to the shop where the pesticides were purchased, always taking together their receipts to prove they were really bought there.

### **Washing of contaminated clothes/ PPE**

It is mainly through this activity that women are directly exposed to pesticides in family farming. In 81.5% of the visited farms, women were responsible for washing the clothes worn by farmers during the preparation and application of pesticides, and the PPE.

The pesticides “safe use” manuals prescribe gloves and apron during this activity<sup>25,28,30</sup>. However, the general framework of misinformation found in family farming of Lavras, as the result of

the negligence of public health, agriculture, work, and environment institutions, as well as of chemical industries, causes the activity to be done in the same way as rural workers usually wash their ordinary clothes (**Table 2**).

According to the “safe use” manuals, the place where contaminated clothes and PPE would have to be washed should be far from the farmers’ houses and from the places where unprotected people walk around. There should be laundry tubs exclusively for washing clothes contaminated by pesticides. Their pipes should be directed to a septic tank for chemical waste treatment. These requirements, which do not take into account the economic and structural context of family farming, were not met at the visited farms (**Table 2**). The lack of a laundry tub only for contaminated clothes and PPE may cause contamination of ordinary clothes, and the dumping of contaminated water in common (not septic) washing tanks may lead to poisoning of people, animals, soil, groundwater, and water streams.

## Conclusion

From the results obtained in this study, we evidenced the infeasibility of family farming in Lavras, Minas Gerais, complying with the pesticides “safe use”. Consequently, the responsibility for the damages and injuries caused by pesticides cannot be attributed to the workers or family farmers. Developed and designed to be used in an agribusiness industrial production structure, the agrochemical technology cannot be adopted under the concepts of safety and hazard control in the economic, social, physical, administrative, and work structure of the studied family farms. Regardless of improving training and schooling level of family

farmers, safety measures complexity and costs are incompatible with their structure. Thus, we state that, the so-called “inadequate”, “improper”, and/or “incorrect” use of pesticides because of rural workers’ “careless”, “negligent”, “disregarding”, “disbelief” attitudes (terms which are adopted even by scientific studies that demonstrate rural workers’ well meaning), the family farmers’ unsafe use of pesticides must be understood and described as being the possible and feasible to be done within the circumstances and their structures.

At this point, without analyzing the (de)merits of agribusiness and its consequences to the Brazilian context of economic and social inequality, of labor precariousness and of hazards to rural workers’ health, we state that the pesticide technology is inherent to the large-scale monoculture productive process, i.e., to agribusiness, and, therefore, must be designed – with restrictions, exceptions, supervision, and perspective of reduced use – only and exclusively for this production model. In the Brazilian family farming context, safe use of pesticides is not feasible. The conclusion of this survey of Lavras family farms may be extended to other family production units in the country, as their production model is common, as shown by the data presented by the 2006 Census of Agriculture<sup>8</sup>, and other studies carried out in several regions of Brazil<sup>36</sup>.

In this research, we have systematically evidenced that the risk of poisoning in the general context of family farming cannot be controlled by the pesticides “safe use” paradigm. Thus, Government and civil society should encourage and support agricultural production models that do not use pesticides, as well as the fairer, more independent, efficient, and profitable productive technologies, as a way to value the family farming characteristics and tradition.

## Authors’ contribution

All authors contributed equally in this study.

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## References

1. Food and Agriculture Organization of the United Nations. International Code of Conduct on Pesticide Management [Internet]. c2007-13 [citado em 2013 dez 19] Disponível em: <http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/en/>
2. Murray DL, Taylor PL. Claim no easy victories: evaluating the pesticide industry's global safe use campaign. *World Dev.* 2000;28(10):1735-49.
3. Wesseling C, Chaverri RFC. Safe use of pesticides: a developing country's point of view. Oxford: Taylor & Francis; 2007. p. 558-81.
4. Brasil. Lei nº 7.802, de 11 de julho de 1989. Dispõe sobre a pesquisa, a experimentação, a produção, a embalagem e rotulagem, o transporte, o armazenamento, a comercialização, a propaganda comercial, a utilização, a importação, a exportação, o destino final dos resíduos e embalagens, o registro, a classificação, o controle, a inspeção e a fiscalização de agrotóxicos, seus componentes e afins, e dá outras providências. *Diário Oficial da República Federativa do Brasil, Brasília*; 12 jul 1989.
5. Brasil. Decreto nº 4.074, de 8 de janeiro de 2002. Regulamenta a Lei nº 7.802, de 11 de julho de 1989, que dispõe sobre a pesquisa, a experimentação, a produção, a embalagem e rotulagem, o transporte, o armazenamento, a comercialização, a propaganda comercial, a utilização, a importação, a exportação, o destino final dos resíduos e embalagens, o registro, a classificação, o controle, a inspeção e a fiscalização de agrotóxicos, seus componentes e afins, e dá outras providências. *Diário Oficial da República Federativa do Brasil, Brasília*; 8 jan 2002.
6. Brasil. Portaria nº 86, de 3 de março de 2005. Aprova a norma regulamentadora de segurança e saúde no trabalho na agricultura, pecuária, silvicultura, exploração florestal e aquicultura – NR 31. *Diário Oficial da República Federativa do Brasil, Brasília*; 4 mar 2005.
7. Rigotto RM, Rosa IF. Agrotóxicos. In: Caldart RS, et al. *Dicionário da educação do campo*. 1ª ed. Rio de Janeiro: Expressão Popular; 2012. p. 86-94.
8. Brasil. Instituto Brasileiro de Geografia e Estatística. Censo Agropecuário 2006 [Internet]. Rio de Janeiro: IBGE; 2009 [citado em 2013 mar 3]. Disponível em: [http://www.mma.gov.br/estruturas/sds\\_dads\\_agroextra\\_arquivos/familia\\_censoagro2006\\_65.pdf](http://www.mma.gov.br/estruturas/sds_dads_agroextra_arquivos/familia_censoagro2006_65.pdf)
9. Oliveira-Silva JJ, et al. Influência de fatores socioeconômicos na contaminação por agrotóxicos, Brasil. *Rev. Saúde Pública.* 2001;35(2):130-5.
10. Faria NMX, et al. Trabalho rural e intoxicações por agrotóxicos. *Cad. Saúde Pública.* 2004;20(5):1298-308.
11. Schmidt MLG, Godinho PH. Um breve estudo acerca do cotidiano do trabalho de produtores rurais: intoxicações por agrotóxicos e subnotificação. *Rev. Bras. Saúde Ocup.* 2006;31(113):27-40.
12. Pignatti WA, Machado JMH, Cabral JF. Acidente rural ampliado: o caso das “chuvas” de agrotóxicos sobre a cidade de Lucas do Rio Verde - MT. *Ciênc. Saúde Coletiva.* 2007;12(1):105-14.
13. Veiga MM, et al. A contaminação por agrotóxicos e os Equipamentos de Proteção Individual (EPIs). *Rev. Bras. Saúde Ocup.* 2007;32(116):57-68.
14. Faria NMX, Rosa JAR, Facchini LA. Intoxicações por agrotóxicos entre trabalhadores rurais de fruticultura, Bento Gonçalves, RS. *Rev. Saúde Pública.* 2009;43(2):335-44.
15. Bedor CNG. Vulnerabilidades e situações de riscos relacionados ao uso de agrotóxicos na fruticultura irrigada. *Rev. Bras. Epidemiol.* 2009;12(1):39-49.
16. Preza DLC, Auguto LGS. Vulnerabilidades de trabalhadores rurais frente ao uso de agrotóxicos na produção de hortaliças em região do Nordeste do Brasil. *Rev. Bras. Saúde Ocup.* 2012;37(125):89-98.
17. Cabral ERM. Exposição aos agrotóxicos: implicações na saúde de trabalhadores agrícolas de uma região de Campinas-SP. Campinas. Dissertação [Mestrado em Saúde Coletiva] – Faculdade de Ciências Médicas, Universidade Estadual de Campinas; 2012.
18. Santana VS, Moura MCP, Nogueira FF. Mortalidade por intoxicação ocupacional relacionada a agrotóxicos, 2000-2009, Brasil. *Rev. Saúde Pública.* 2013;47(3):598-606.
19. Salvi RM, et al. Neuropsychiatric evaluation in subjects chronically exposed to organophosphate pesticides. *Toxicol Sci.* 2003;72:267-71.
20. Neves PDM, Bellini M. Intoxicações por agrotóxicos na mesorregião norte central paranaense, Brasil – 2002 a 2011. *Ciênc. Saúde Coletiva.* 2013;18(11):3147-56.
21. Chrisman JR, et al. Pesticide sales and adult male cancer mortality in Brazil. *Int J Hyg Environ Health.* 2009;212(3):310-21.
22. Abreu PHB, Alonzo HGA. Trabalho rural e riscos à saúde: uma revisão sobre o “uso seguro” de agrotóxicos no Brasil. *Ciênc. Saúde Coletiva.* 2014;19(10):4197-208.
23. Brasil. Censo demográfico 2010 [Internet]. Rio de Janeiro: IBGE, 2011 [citado em 2013 mar 3]. Disponível em: [http://www.censo2010.ibge.gov.br/resultados\\_do\\_censo2010.php](http://www.censo2010.ibge.gov.br/resultados_do_censo2010.php)
24. Cochran WG. *Sampling Techniques*. New Jersey: John Wiley & Sons; 1977.
25. Iwami A, et al. *Manual de uso correto e seguro de produtos fitossanitários*. São Paulo: Linea Creativa; 2010.

26. Associação Nacional de Defesa Vegetal. Manual de armazenamento de produtos fitossanitários. Campinas: Linea Creativa; 2010.
27. Associação Nacional de Defesa Vegetal. Manual de transporte de produtos fitossanitários. Campinas: Linea Creativa; 2010.
28. Associação Nacional de Defesa Vegetal. Manual de uso correto de equipamentos de proteção individual. Campinas: Linea Creativa; 2003.
29. Associação Nacional de Defesa Vegetal. Manual de segurança e saúde do aplicador de produtos fitossanitários. Campinas: Linea Creativa; 2006.
30. Associação Nacional de Defesa Vegetal. Boas práticas agrícolas no campo [Internet]. c2010 [citado em 2013 mar 21]. Disponível em: [http://www.andefedu.com.br/uploads/img/manuais/arquivo/manual\\_de\\_boas\\_praticas.pdf](http://www.andefedu.com.br/uploads/img/manuais/arquivo/manual_de_boas_praticas.pdf)
31. Brasil. Cartilha sobre Agrotóxicos: série trilhas do campo [Internet]. 2011 [citado em 2013 mar 2]. Disponível em: <http://portal.anvisa.gov.br/documents/111215/451956/Cartilha+sobre+Agrot%C3%B3xicos+S%C3%A9rie+Trilhas+do+Campo/6304f09d-871f-467b-9c4a-73040c716676>
32. Chaim A, Frighetto RTS, Valarini PJ. Manejo de agrotóxico e qualidade ambiental: manual técnico. Jaguariúna: Embrapa Meio Ambiente; 1999.
33. Garcia EG, Alves Filho JP. Aspectos de prevenção e controle de acidentes no trabalho com agrotóxicos. São Paulo: Fundacentro; 2005.
34. Brasil. Lei nº 11.326, de 24 de julho de 2006. Estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais. Diário Oficial da República Federativa do Brasil, Brasília; 25 jul 2006.
35. Epidata. Computer program, version 2.2.2.182. Odense (Denmark): EpiData Association; 2000-2008.
36. Rigotto RM. O Censo e os agrotóxicos: o uso seguro é possível? 17 dez 2010 [citado em 2014 jan 20]. In: Comissão Pastoral da Terra [Internet]. Goiânia: CPT. Disponível em: <http://www.cptnacional.org.br/index.php/publicacoes-2/noticias-2/15-artigos/509-o-censo-e-os-agrotoxicos-o-uso-seguro-e-possivel>