Pilot study on agricultural pesticide poisoning in Burkina Faso

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ABSTRACT

Epidemiologic data related to agricultural pesticide poisoning cases in Burkina Faso were collected. The study was carried out using retrospective (from January 2002 to June 2010) surveys conducted among farmers and healthcare centers. One hundred and fifty-three (153) pest control products were recorded during the survey and 56 active ingredients were identified. Out of the 153 pest control products, 49 (i.e. 32%) were authorized for sale in Burkina Faso. The main risk factors are socio-demographic characteristics of farmers, their low education level, and some attitudes and practices on using agricultural pesticides. Pesticide poisonings are relatively frequent and their management was not always efficacious. Actions are needed to reduce pesticide poisoning as a global public health problem and to improve management of pesticide poisoning. To this purpose, advanced investigations should be carried out over a longer period of time to complement the present pilot study.

KEY WORDS: pesticides; poisoning; farmers; Burkina Faso

Introduction

The agricultural sector is very important in the national economy of Burkina Faso. As a matter of fact, it employs 86% of the total population and generates about 40% of the gross domestic product (GDP). Diseases and animal pests cause major damage in agriculture and can be responsible in some cases for up to 30% of yield losses in Burkina Faso. Thus plant protection products are used to eradicate pests affecting crops, particularly in the case of intensive cultures such as cash crops, sugarcane, vegetable crops, and to a lesser extent fruit trees (MAHRH, 2007). In 1997, more than 2,500 tons of pesticide formulations were estimated to be used in Burkina Faso and that only for the treatment of cotton, vegetables and the consumption of plant protection services (Van Der Valk & Diarra, 2000). The annual growth rate of pesticide consumption reached 11% (Toe & Kinane, 2004). Pesticides are considered as one of the main factors of rural development at a time when demographic and economic constraints increase the pressure for productivity growth. They help to reduce the damage caused to crops by pests and even to prevent them. However, pesticides constitute a real threat for health and environment in Burkina Faso (Ouédraogo et al., 2009).

Several studies carried out in Burkina Faso have shown that agricultural producers did not follow good agricultural practices (Domo, 1996; Ouédraogo et al., 2009; Toe et al., 2002; Toe et al., 2012). Yet, to the best of our knowledge, recent data on agricultural pesticide poisoning in Burkina Faso are not available. Our study aimed at collecting epidemiologic data related to agricultural pesticide poisoning cases in Burkina Faso.

Methods

Study area

Field work (surveys and interviews) took place in the agricultural areas of the “Hauts-Bassins”, the “Cascades” and the “Boucle du Mouhoun”. They are the biggest cotton producing zones of Burkina Faso and the major users of agricultural pesticides. The “Hauts-Bassins”, the “Boucle du Mouhoun” and the “Cascades” regions had a population of 1,389,258 inhabitants, 1,478,392 inhabitants, and 430,677 inhabitants, respectively in 2006, i.e. about 23% of the national population. Survey sites were selected on the basis of their agro-climatic characteristics, their
geographic situation, the extent of cultivated crops such as cotton, maize and rice on which pesticides were highly used. The sites were selected on the basis of the above-mentioned criteria (Figure 1).

**Design of the study**

Relevant administrative and technical services were contacted to collect preliminary data on the number of farms and their different categories. On the basis of the data obtained, a random sampling was done to identify persons to be surveyed.

Prospective studies were conducted to monitor agricultural producers during pesticide application operations and to identify weaknesses and strengths of producers’ pesticide management (type of pesticide, safety measures, management of agro-chemical stocks, left-over pesticides).

As for epidemiological data from pesticide-related poisoning, a retrospective study was done. It was conducted from June to July, 2010. All pesticide-related poisoning cases admitted in healthcare centers from January 2002 to June 2010 were included.

In each department (survey site), farmers of fifty farms were selected. In order to take into consideration the different categories of agricultural producers, a stratified sampling based on the size of the farms was created. Based on the size of farms, the following four groups were taken into account:

- **Group I**: Less than 1000 m²
- **Group II**: Between 1000 and 2500 m²
- **Group III**: Between 2500 and 5000 m²
- **Group IV**: More than 5000 m²

The total number of farms per department and the number of farms of each group was assessed in order to do the sampling. The representativeness (group coefficient) of each group in the department was calculated on the basis of the total number of farms per group as follows:

**Number of farms in the group**

\[
\text{Number of farms in the group} = \frac{\text{Number of farms in the group}}{\text{Total number of farms in the department}}
\]

To determine the number of farms from each group that should be part of the fifty farms selected for the sampling, we multiplied 50 by the group coefficient.

All the healthcare centers of the survey sites were systematically included to the study.

**Investigations among farmers and healthcare centers**

Investigations among farmers consisted in collecting data on pesticides used by farmers and their attitude when poisoning by pesticides would occur. In healthcare centers, surveys aimed to record poisoning incidents. The investigations were designed to collect reliable and well-documented information. Following a questionnaire, interviews were conducted among healthcare agents to record and describe poisoning incidents caused by pesticides.

**Data processing and analysis**

After the perusal of survey sheets, data were codified, entered and analyzed using the data management software Epi Info 3.3.2 and Excel 2007 software. Results were summarized into descriptive statistics.

**Results**

**Risk factors of poisoning**

A total of 650 farmers distributed in 16 villages of the three regions studied were surveyed. Pesticides were mostly handled by men. In fact, 98.3% of the surveyed persons involved in the application of pesticides were men. The average age of the farmers was 39.58±10.30 years. The youngest person involved in pesticide application operations was 17 years old and the oldest one was 75; 15.3% of the farmers were more than 50 years old.

One hundred and fifty-three (153) pest control products (pesticides) were recorded during the survey and 56 active ingredients were identified (Table 1). Out of the 153 pest control products, 49 (i.e. 32%) were authorized for sale by the Sahelian Pesticide Committee, hence in Burkina Faso. Pesticides of classes I, II, III and IV (WHO classification) were indistinctly used. The main categories of pesticides found were herbicides, insecticides and fungicides. The majority of the surveyed population (60.5%) had no education at all, 31.8% of them had primary
### Table 1. Pesticide formulations which were identified during the survey among dealers.

| Formulation          | Active ingredients   | Pesticide category | WHO Class | Sources of chemicals |
|----------------------|----------------------|--------------------|-----------|----------------------|
| ACEPRONET 400        | Acetochlore           | Herbicide          | III       | China                |
| ACTELLIC SUPER      | Pyrimiphos-methyl     | Insecticide        | II        | France               |
| ACTELLIC 50          | Pyrimiphos-methyl     | Insecticide        | III       | Switzerland          |
| ACTELLIC SUPER      | Pyrimiphos-methyl     | Insecticide        | III       | SAPHYTO               |
| ACTION B20 F        | Duvax                 | Herbicide          | SCAB      |                      |
| AEWIMA HERBA        | Glyphosate            | Herbicide          | China     |                      |
| AEWIMA HERBA 75.7%  | Glyphosate            | Herbicide          | China     |                      |
| AGRAZINE 500        | Atrazine              | Herbicide          | China     |                      |
| AGRAZINE 80 WP      | Atrazine              | Herbicide          | France/China |                    |
| AGRAZINE DF         | Atrazine              | Herbicide          | France    |                      |
| AKDON 41 SC         | Nicosulfuron          | Herbicide          | III       | France               |
| ALLAGARON 400 DC    | Prometryne           | Herbicide          | III       | France               |
| AMPAR PLUS 50 DC    | Metalaxyl-M           | Insecticide        | II        | Switzerland          |
| AMPAR STAR 42 WS    | Thiamethoxam          | Herbicide          | Switzerland |                |
| ATRAHERIN           | Atrazine              | Herbicide          | China     |                      |
| ATRALM 500          | Atrazine              | Herbicide          | SENEFURA  |                      |
| ATRALM 50           | Atrazine              | Herbicide          | SAPHYTO   |                      |
| ATRAZ 50            | Atrazine              | Herbicide          | Cantonments Acura |            |
| ATRAZ 90 WP         | Atrazine              | Herbicide          | SANKO/AGROCHEM |          |
| ATRAZILLA 300       | Atrazine              | Herbicide          | Kumark Trading Ent. |           |
| ATRAZILLA 80 WP     | Atrazine              | Herbicide          | Shrenan/Baunch Chemical industry v. Ltd | |
| ATRAZINE            | Atrazine              | Herbicide          | Japan     |                      |
| ATRAZINE WEEDCIDE   | Atrazine              | Herbicide          | Japan     |                      |
| AWAMEET 500 DC      | Indoxacarb            | Herbicide          | SAPHYTO/SAPFEX |      |
| BACCAIRA 335 DC     | Propargyl | Herbicide          | SAPHYTO   |                      |
| BENKAZINE SUPER     | Paraoxyzin            | Herbicide          | Bentomixic Productions| |
| BESTRA              | 2,4-D                 | Herbicide          | CaliHusa/Ghana Bentrench Productions | |
| BESTRA 10 WP        | Bifenthrine           | Herbicide          | II        |                      |
| BLAST 46 EC         | Lambda cyhalothrin    | Insecticide        | SAPHYTO   |                      |
| CANMANHURGEE        | Endosulfan            | Herbicide          | SII       |                      |
| CANMAN SUPER        | Anoplocarnosin        | Herbicide          | SII       |                      |
| CALFOS 500 DC       | Profenofos            | Herbicide          | SAPHYTO   |                      |
| CALLFOR             | Prometryne            | Herbicide          | SAPHYTO   |                      |
| CALLFOR 500         | Prometryne            | Herbicide          | SAPHYTO   |                      |

### Table 1. Pesticide formulations which were identified during the survey among dealers.  

| Formulation          | Active ingredients   | Pesticide category | WHO Class | Sources of chemicals |
|----------------------|----------------------|--------------------|-----------|----------------------|
| CALLUSBG            | Prometryne           | Herbicide          | II        | SAPHYTO               |
| CALLUSMB            | 2,4-D of amom-salt   | Herbicide          | SAPHYTO   |                      |
| CALLUS M90 WP       | Mersule              | Fungicide          | Callowine |                      |
| CALLUSRA310 VG      | Atrazine             | Herbicide          | SAPHYTO   |                      |
| CALLUSRENE SUPER    | Paraoxyzin           | Herbicide          | SAPHYTO   |                      |
| CALZAT              | Propargyl triflupraz | Herbicide          | SAPHYTO   |                      |
| CALTHO C            | Cypermethrin-ethyl   | Insecticide        | SAPHYTO/FAGRODEP |          |
| CALTHO DS           | Lendane              | Herbicide          | SAPHYTO   |                      |
| CALTHO E            | Endosulfan           | Insecticide        | SAPHYTO   |                      |
| CAPT 90 EC          | Acmaminopride        | Insecticide        | SAPHYTO   |                      |
| CAPT 90 EC          | Acmaminopride        | Insecticide        | II        | Ivory Coast/JALN     |
| CARBAION 31% G      | Carbrousin           | Herbicide          | Maldatherm/Agri France | |
| CELICLAC 12,5 EC    | Benstances           | Insecticide        | SAPHYTO   |                      |
| CIGOGNE             | Prodimin             | Herbicide          | STPC/Abidjan |          |
| CORDIAL gold 425,5 EC | 5-Methylthiouracil | Herbicide          | SAPHYTO/SYNGENTA | |
| CONQUEST C 48 EC    | Acmaminopride        | Insecticide        | SAPHYTO   |                      |
| CONQUEST C 176 EC   | Acmaminopride        | Insecticide        | SAPHYTO   |                      |
| COTODION PLUS 500 EC | Metalachlor          | Herbicide          | SII       | NOVARITIS            |
| COTONET 500 EC      | Metalachlor          | Herbicide          | DTE SA/Chane |          |
| CUCURON 500 SC      | Prodimin             | Herbicide          | SORTEX    |                      |
| CYPERCAL 25 EC      | Cypermethrin         | Insecticide        | SAPHYTO   |                      |
| CYPERCAL 50 EC      | Cypermethrin         | Insecticide        | SII       |                      |
| CYPERCAL P 9410 EC  | Prodimin             | Insecticide        | SAPHYTO   |                      |
| CYPERWOSH           | Cypermethrin         | Insecticide        | Bayer crop science | |
| CYREN 480 EC        | Chlorpyrifos-ethyl   | Insecticide        | SANYA     |                      |
| DECO                  | Benstances           | Insecticide        | STPC/Bayer crop science | |
| DECIMOC 12,5        | Benstances           | Insecticide        | SAPHYTO   |                      |
| DIFURAN             | Carbouxin            | Insecticide        | SAPHYTO   |                      |
| DIFA GALA 300 SL    | Glyphosate            | Herbicide          | PROPTIMA/SARWAMA |          |
| DUHALAM 90 MG       | Duron                 | Herbicide          | SII       |                      |
| DOMINEX 100         | Alpha-cypermethrin   | Insecticide        | SII       |                      |
| DUSYFA              | Chlorpyrifos-ethyl   | Insecticide        | SAPHYTO   |                      |
| ENDOSOL 500 EC      | Endosulfan           | Insecticide        | Insecticide | SORTEX |
| FANGA 50 EC         | Prodimin             | Insecticide        | SII       |                      |
| FOCUS GLYPSARATE 360 SL | Glyphosate          | Herbicide          | SORTEX    |                      |
| FOCUS Ultra 100 EC  | Cyclodione           | Herbicide          | SII       | BASF/tech AGRO inter- national |
### Table 1 - cont. Pesticide formulations which were identified during the survey among dealers.

| Formulation          | Active ingredients | Pesticide category | WHO Class | Sources of chemicals       |
|----------------------|--------------------|--------------------|-----------|-----------------------------|
| FURADAN 5G           | Carbofuran         | Insecticide        | SCAB/TAMC |                             |
| FUSILADE             | Fluazifop-p-butyl  | Herbicide          | III       | SCAB                        |
| GALAXY 400 EC        | Clomazone          | Herbicide          | SINEFERA/SAPHYTO |
| GALLANT SUPER        | Haloxyfop-R-methyl | Herbicide          | III       | Calvare                     |
| GARE 452 EC          | Tebuconazole       | Herbicide          | II        | SAPHYTO                     |
| GYSELI 410 SL        | Glyphosate         | Herbicide          | II        | Top phytes/Topex Agri          |
| GYSEPON 75           | Glyphosate         | Herbicide          | III       | SCAB                        |
| GALFINE 500 WG       | Glyphosate         | Herbicide          | III       | SINEFERA/ALM                  |
| GALFIN 500 SL        | Glyphosate         | Herbicide          | III       | SINEFERA/ALM                  |
| GALLON 720           | Glyphosate         | Herbicide          | III       | SINEFERA/ALM                  |
| GYPOHON 360 SL       | Glyphosate         | Herbicide          | III       | DTE SA China                 |
| GYSELI               | Glyphosate         | Herbicide          | II        | Yaw wawu Ventures            |
| GRANODERM SUPER      | Paraquat-chloride  | Insecticide        | Kumark Trading Ext. |
| GRANODIME SUPER      | Paraquat           | Insecticide        | II        | SCAB                        |
| HALO Ket 500 EC      | Haloxyfop-R-methyl | Herbicide          | III       | DTE SA China                 |
| HERBALIM             | 2,4-D of amino salt| Herbicide          | SEINEFURA/ALM       |
| HERBEKTRA 720 SL     | 2,4-D of amino salt| Herbicide          | II        | SCAB, Kumark Trading Ext., SSI |
| HERBEKTRA 750 SL     | 2,4-D of amino salt| Herbicide          | II        | SCAB                        |
| HERBSUPER            | Atrazine           | Herbicide          | II        | SCAB                        |
| HERimenti            | Atrazine           | Herbicide          |            | SCAB                        |
| HERMABIS            | Nicosulfuron       | Herbicide          | II        | SAPHYTO, SURALTEX-          |
| IBIS A               | Alphachloropirimidine | Insecticide            | SCAB/CSI     |
| IBIS P               | Alphachloropirimidine | Insecticide            | SSI        |
| HERAIDINE            | Haloxyfop-R-methyl | Herbicide          | II        | SCAB                        |
| KALACH 360 SL        | Glyphosate         | Herbicide          | III       | SAPHYTO/Califahina          |
| KALACH EXTRA 78 SL   | Glyphosate         | Herbicide          | III       | SAPHYTO                      |
| KAMARINE             | Pendimethaline     | Herbicide          |            | Kumasi Ghana                |
| KART 500 SP          | Carbazate          | Insecticide        | II        | STEPC                      |
| KONBRA               | Lambda-cyhalothrin | Insecticide        |            | SARO                        |
| KURAPA MERA          | Glyphosate         | Herbicide          |           |                             |
| KURAPA NIRA          | Glyphosate         | Herbicide          |           |                             |
| KURAPA NIRA          | Glyphosate         | Herbicide          |           |                             |
| LAGON 300 SC         | Imidacloprid       | Herbicide          | III       | STEPC/Bayer crop science   |
| LAMIRDA SUPER        | Lambda-cyhalothrin | Insecticide        | SCAB, Kumark Trading Ext. |
| LAMIRDA P 212 EC     | Lambda-cyhalothrin | Insecticide        |            | SAPHYTO                      |
| LAMIRDA P 614 EC     | Lambda-cyhalothrin | Insecticide        |            | SORTEX                      |
| LAMINEX 430 EC       | Lambda-cyhalothrin | Insecticide        | III       | Malathion Chemical Works    |
| LASSO                | Atrazine           | Herbicide          | III       | SCAB/Candol                 |
| LAYA                 | Atrazine           | Herbicide          | III       | SCAB/Candol                 |
| LAURO 100 EC         | Haloxyfop-R-methyl | Herbicide          | III       | SAPHYTO                     |
| LAURO BRIEBA         | 2,4-D              | Herbicide          | III       | SAPHYTO                     |
| LETATE               | Glyphosate         | Herbicide          | Topaz Multiindustries Ghana |
| LIVOR                | Fenvalerate        | Insecticide        |            | Bentomin Products            |
| LOMAZA 45 WS         | Imidacloprid       | Insecticide        | III       | PROPAYMA/Savana              |
| LRK 400              | Nicosulfuron       | Herbicide          | III       | PROPAYMA/Savana              |
| LPSMURA              | Glyphosate         | Herbicide          |            |                             |
| OXAZIR 250 EC        | Oxadiazon          | Herbicide          | III       | SAPHYTO                     |
| PACHA 25 EC          | Lambda-cyhalothrin | Insecticide        | II        | SAPHYTO                     |
| PHOSDIN              | Phosphae d’alumine | Insecticide        |            | Kumark Trading Ext.         |
| POWER                | Glyphosate         | Herbicide          |            |                             |
| POWER GYPSAITE 4000 _ P.A. | Glyphosate | Herbicide          |            | SYNGENTA                    |
| PRAWAGRAM 360        | Atrazine           | Herbicide          | II        | SYNGENTA                    |
| PROTECTOR            | Lambda-cyhalothrin | Pymorphyazine      | Insecticide | SINEFURA, SURALTEX-          |
| ROSTAR               | Oxadiazon          | Herbicide          |            | SCAN                        |
| RIZTOP 250 EC        | Oxadiazon          | Herbicide          | III       | SAPHYTO                     |
| ROXY 366 EC          | Endosulfan         | Herbicide          | III       | SAPHYTO                     |
| ROXY 80 g/L          | Glyphosate         | Herbicide          |            |                             |
| ROXY 80 g/L          | Glyphosate         | Herbicide          |            |                             |
| SHAEWURA             | Glyphosate         | Herbicide          |            |                             |
| SINOSATE             | Glyphosate         | Herbicide          |            |                             |
| SPRAYMIST             | Phosphae d’alumine | Insecticide        |            | SURALTEX                    |
| STORM                | Pendimethaline     | Herbicide          |            | SURALTEX                    |
| STORM 500 EC         | Pendimethaline     | Herbicide          |            | SORTEX                      |
| SUPRAFREE             | Paraquat           | Insecticide        |            | Golden stock                |
| SUGA SUPER 50        | Ozone-Cyhalothrin  | Herbicide          | III       | SAPHYTO/SURALTEX            |
| TEMPRA               | Diron              | Herbicide          |            | SAPHYTO                     |
| TERMACAL 400 EC      | Chlorophenoxy-ethyl | Insecticide        |            | SAPHYTO                     |
| THAN 15Y D-TQ        | Spintexirotamides  | Insecticide        | III       | SCAB/Bayer crop science     |
| TTU 25 EC            | Atrazine           | Insecticide        |            | SAPHYTO                     |
| TOPSAR               | Oxadiazon          | Herbicide          | III       | SCAL, SAPHYTO                |
| TOUCHDOWN            | Glyphosate         | Herbicide          |            | SYNGENTA                    |
| TOUCHDOWN H.TECH     | Glyphosate         | Herbicide          |            |                             |
| TRAZIME              | Atrazine           | Herbicide          |            | Bentomin Products            |
| WEED FAST            | Glyphosate         | Herbicide          |            | WESTUNG CR Kumasi           |
education, and 7.7% had a secondary education level. Thirty-nine percent of the farmers had less than 10 years’ experience in pesticide use, whereas 54% had between 10 and 30 years’ experience.

Our study showed that the pesticide application equipment used was mainly backpack sprayers with a volume capacity of 10 to 20 liters (in 96% of cases) and Ultra Low Volume sprayers (ULV) or Ultra Bas Volume (UBV) sprayers with a volume capacity ranging from 1 to 5 liters (4% of cases).

Some of the farmers (24.45%) reported not having any left-over pesticides as they knew the exact quantities required for treatment. Most of the surveyed farmers (69.12%) kept their unused pesticides for further applications. They stored them at their place or in the fields. A few of them declared dumping them into nature (4.86%) or burying them (1.72%).

The individual protective equipments that were widely used by farmers were masks (40% of farmers use them) followed by boots (28.8%), while overalls tend to be seldom used (4.5%). Only rarely did the farmers use a combination of two or more protective gears (Figure 2). Very few farmers have full protection (0.93%).

The majority of the farmers (67.5%) reported having a watering place in their fields or less than 100 meters from the fields; 13.63% of the farmers had a watering place situated between 100 and 500 meters from the fields. The survey revealed that water from 50% of the watering places was used for human consumption, 29.26% for diluting pesticides, and 26.96% for animal consumption.

**Types of ailments affecting farmers**

Figure 3 shows the distribution of the different types of ailments affecting farmers during or just after pesticide application. The majority of the surveyed farmers (82.66%) reported having experienced, at least on one occasion, a feeling of ill-health during or just after pesticide applications. The exposure routes were dermal, respiratory, ocular and oral (Figure 4).

**Management of poisoning incidents by farmers**

Table 2 summarizes the farmers’ attitude when poisoning incident would occur.

**Poisoning data**

A total of 42 healthcare centers were covered by the study, of which 40 health and social advancement centers and two health centers with surgical facilities (CMA). About 922 cases of pesticide poisoning (without detailed information) were reported. Pesticide poisoning cases reported with brief information included intoxication cases for which basic information is available. The information provided is related to the identity of the injured person (sex and age), the incident circumstance and its outcome. A total of 81 recorded poisoning cases fell into this category. The majority of victims were women (70.37%). The largest proportion of victims were adults (>19 years old) (54.33%), 19.75% were children (<14 years old), and 17.28% adolescents (14–19 years old). In 8.84% of the cases, age could not be identified. The majority of poisoning cases (53%) were due to unintentional ingestion of pesticides. It was reported that 28% of the cases were intentional (suicide).
and 19% of the cases occurred while using pesticides in fields. As shown in Figure 5, the number of poisoning cases increased annually. The majority of victims, i.e. 80.25%, recovered whereas in 10% of cases poisoning was fatal. In 9.75% of cases, the outcome was unknown. Out of the 42 surveyed health officers, 20 (47.62%) declared not having much knowledge about pesticides, while 22 (52.37%) knew some facts about pesticides.

Discussion

Certain behaviors and practices were identified to predispose to pesticide exposure and illness. The majority of the farmers using pesticides were relatively young (mean age 39.58 years). However, some were old, i.e. more than 50 years old (15.3%). This raises some concerns as it is known that the functional capacity of human vital organs, such as kidneys, decreases with age. Consequently, old age contributes to increase health risks related to the exposure of pesticides (Klaasen, 2007).

The large number of pesticides (153 products) used by farmers (which were often banned) could be factors contributing to health risks of pesticides (Mansour, 2004). Farmers usually combined insecticides of different classes in a single spray. Overall the level of education of the surveyed farmers was low (more than 60% of them are illiterates). They cannot read labels and follow recommended instructions for the proper use of pesticides. This fact does hinder the implementation of a scheme aimed at reducing health risks. However, farmers who have acquired literacy in the indigenous language can constitute an asset for the community. As a matter of fact, training programs on the management and proper use of pesticides can be designed and provided in the local language. Such programs could initially target a restricted number of individuals who will eventually be requested to take over training among the other members of the community.

The study showed that the extent of the farmers’ experience related to the use of pesticides varied considerably. About 54% of the farmers had between 10 and 30 years’ experience. This is very significant and indicates chronic exposure among these farmers (Konradsen, 2007). Contrary to the idea that experience can be an asset, we found that pesticide operators with the longest experience did not necessarily give the best example (Ouédraogo et al., 2009). They were applying pesticides without personal protective equipments on the pretense that there were no risks in handling pesticides.

The conclusion drawn on pesticide management practices among farmers is that the careless habit of storing pesticides at home severely exposes family members to risks in terms of health, while discharging them into the environment or burying them inevitably leads to environmental contamination.

Pesticide application equipments used by the farmers were portable equipments which are manually operated. This situation also predisposed farmers to pesticide exposure. In India, it was found that tractor mounted techniques were only for big farms; the most commonly used equipment was hand-carried lever operated knapsack sprayer, which is not a very well designed mounted technique (Abhilash & Singh, 2009).

The scarce use of personal protective equipment and the tendency to have only partial protection inevitably leads to high exposure risks among pesticide applicators (Figure 2). Protection was usually incomplete, which outlines the different set of personal protective equipment worn by farmers during pesticide applications. Less than 1% of the

![Figure 5. Distribution of the number of intoxication cases according to the year of occurrence.](image-url)
farmers (0.93%) had full protection. The vicinity of watering sources to fields increases the risks of water contamination by pesticides released through different mediums. Pesticides belonging to the WHO class I₃ are highly hazardous and can be used only by certified and trained applicators and under close supervision. The use of such products should be strictly forbidden to farmers who have no training, who do not have appropriate personal protective equipment and who tend to underestimate pesticide-related hazards (WHO, 2004). Pesticides of Class II are considered as moderately hazardous and their use is restricted to trained applicators under close supervision who strictly comply with recommended precautionary measures. Some pesticides of WHO Class III were used; they are rated as slightly hazardous and can be used by trained applicators who comply with recommended precautionary measures. Well-trained farmers who would comply with recommended patterns of use and safety requirements should be able to handle these products with no major risk of intoxication. Pesticides of WHO class IV do not present acute hazards under normal use (WHO, 2004). Complying both with restrictions of use and precautionary measures is a way for pesticide applicators to ensure their safety.

Most farmers (82.66%) complained of discomfort during or just after pesticide applications while 17.34% of them never felt anything. Ailments affecting the central nervous system (experienced by 48.92% of farmers) were most reported by the farmers. As a matter of fact, exposure to insecticides is known to have severe adverse effects on the nervous system (Multinigner, 2005; Toe et al., 2012).

As shown in table 2, a large proportion of farmers had recourse to traditional medicine when intoxication incident would occur. This is not surprising as it is known that 80% of the populations in developing countries use medicinal plants to cure themselves (OMS, 2002). Only 3.08% of farmers would go to healthcare service centers.

The majority of the acute-poisoned patients were females and adults; this could be explained by the high prevalence of illiteracy among females in developing countries. Moreover, adults have free access to pesticides in rural areas. In fact, like in other developing countries, anyone is allowed to buy, handle and apply toxic agricultural chemicals without any necessary safety procedures (Lee & Cha, 2009). Thus majority of cases of pesticide poisoning cases were accidental (53%). The lethality due to pesticides poisoning was relatively high (about 10%); this could be explained by the inappropriate first aid attitude and the delay in admittance to healthcare centers.

Conclusion

Particular socio-demographic factors, such as female sex, elderly age, and low education were related to increased risk of pesticides. Some attitudes and practices of farmers were also identified to predispose to agricultural pesticide exposure and illness in Burkina Faso. The management of agricultural pesticides in Burkina Faso was complicated by the number of different classes of pesticides which are highly or moderately toxic. Pesticide poisonings were relatively frequent. The most important policy change to reduce mortality from acute pesticide poisoning would be to phase out the most toxic chemicals, namely the WHO class I and II pesticides, and substitute them with less toxic groups of pesticides. Moreover, agricultural policies must reduce the use of pesticides to the lowest level feasible. Actions are needed to reduce pesticide poisoning as a global public health problem and to improve management of pesticide poisoning. To this purpose, advanced investigations should be carried out over a longer period of time to complement the present pilot study.

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