Extremely Hazardousand Highly Hazardous Pesticides Registered For Pests Control because of lack of Slightly Hazardous Alternatives

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Abstract - Registration of pesticides begun in Central Africa specifically in Cameroon since 1996. Less than 5% of pesticides used in 2004 were registered and more than 80% of producers were not aware of this legal process. In 2014, 85% of pesticides used are registered. In Subsaharan Africa, registered HHP are rondenticides, insecticides and nematocides, frequently used for the protection of stored products. Licit POP (heptachlore, chlorobenzène) and HHP (alluminium phosphide, terbufos, abamectine, ethropophos, …) are frequently used to protect stored grains. 40% are registered for use in intensive bananas production (28% for nematodes control alone and 10% for control of both insects and nematodes). 20% of highly hazardous pesticides (HHP) are registered for the control of rondents. Only 4 active ingredients are registered and used for the formulation of 7 alternative slightly hazardous pesticides.

Keywords: Cameroon, chemical pest control, highly hazardous pesticides, alternatives.

I. INTRODUCTION

The population of the African continent approximated 1.03 billion in 2011, it will double by the year 2050. There is a need to increase agricultural production by increasing productions or preventing pre and post-harvest losses. Many pests attack and destroy crops on fields and during storage. The most useful tools to avoid losses are chemical pesticides.

A closer look on pesticides frequently used in crop protection in sub-Saharan Africa makes obvious their poor quality.Around 30% counterfeit pesticides are available on markets, many of registered pesticides seem to be ignored by farmers and most of those in use are not registered1. A permanent survey of the conventional pesticides used in the northern Cameroon and western Chad from 2004 till 2011 pointed out that: 12% of the pesticides are obsoletes and mainly POP, 12% belong to the class Ib (highly hazardous pesticides) of the WHO classification of pesticides by hazards[2], 60% belong to the class II (moderately hazardous)and 6% to the class III (Slightly hazardous)[1]. Depending to their structure, pesticides currently used in the Logone valley belong to 4 major families, the most important are the organochlorinated compounds (56%), followed by pyrethrinoids (21%), organophosphorous compounds (17%) and carbamates (6%)[4].

In Cameroon, less than 5 of more than 550 pesticide formulations registered are bio insecticides that may be used as alternatives3. They have as active ingredient spinosad, azadirachtin,toxin of *Bacillus thuringiensis*(Bt). The most popular active ingredient in both Central (Central African Committee for Pesticides) and West Africa (Sahelian Committee for Pesticides)[5] is the cypermethrine, contributing in the formulation of more than 30 commercial products.

Themanagement of pesticides in Sub-Saharan countries is in accordance with the rules and regulations of the CPAC and CSP. In spite of all these regulating frameworks, many mismanagements of pesticides are observed in this area. There is a need to urgently address this chemicals management problem, the present investigation aims to contribute to that.

II. METHODOLOGY

To access the diversity of pesticides used by smallholders to protect crops from insect pest attack, since 2004, yearly sampling of names of pesticides used and collection of pesticides containers were carried out in the 3 northern regions of Cameroon from farmers and dealers. Moreover, the list of authorized pesticides was established by consulting two official releases. The first is from the Cameroon National

Committee of Regulation and Quality control of inputs and agricultural products which is in charge of the registration of pesticides in Cameroon1. These products are also used in neighboring countries in Central Africa where no registration authority is functioning. The second list is from the Sahelian Committee of Pesticides who is in charge of the registration of all pesticides in use in the West Africa countries5. These lists are updated twice a year. The cited pesticides are classified according to their hazards following the Guidelines to classification[3].

III RESULTS

III.1. Typology of the pesticides in the hands of smallholders for crop protection

Pesticides registered for central or for West Africa include 10 categories of products:

- avicides,
- fungicides,
- herbicides
- Insecticides-fungicides,
- insecticides - acaricides
- insecticides-nematocides,
- insecticides
- nematocides,
- molluscides,
- rodenticides

In Central Africa, 4 other categories are added: adjuvants, growth regulators, public hygiene products and resistant activators. A last category is that of pesticides receiving temporary authorization to be sold.

Since its first implementation of registration of pesticides in 1996, Cameroon government is improving the quality and the availability of pesticides offered to producers. Less than 5% of the farmers in 2004 used registered pesticides, 10 year after, more than 80% of the pesticides used are registered. In the same way the amount of users ignoring registered pesticides is reducing moving from 50% in 2004to less than 10% 10 years after.

The compilation of the pesticides names collected from users' citation or read on containers collected in their environment allow to come to a list of used pesticides. This list was made and from year to year and regularly updated. In comparison with the list of the pesticides homologated, 3 situations were currently observed:

- pesticides used which are registered;
- pesticides used which are not registered
- pesticides registered which are not used or not known.

The illustration of the evolution of this situation during the last 10 years is compiled in the figure 1. It raises from there a positive change in the better use of pesticides quality in the crop protection in Sub-Saharan Africa.

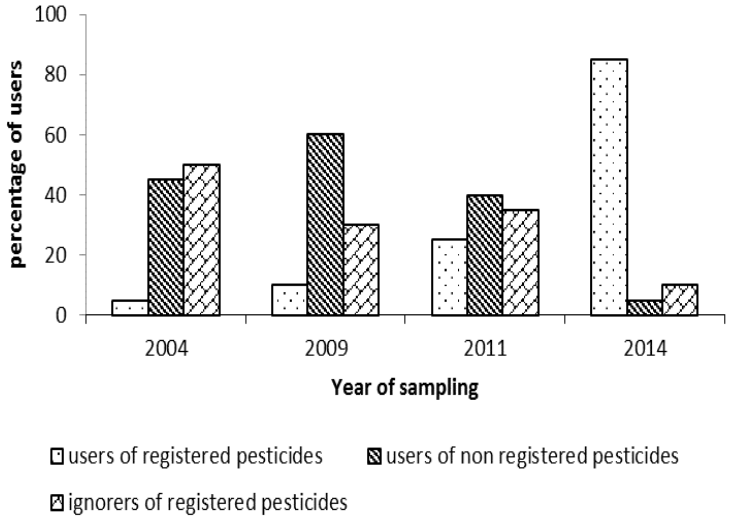
III.2. Occurrence and uses of highly hazardous pesticides

The classification of active ingredients according to the WHO recommended classification of pesticides by hazard was used to categorize pesticides on the list of chemical made from year to year.

A total of 10 highly hazardous active ingredients of pesticides are currently used in Central and West Africa in the formulation of fungicides, herbicides, insecticides, insecticides-acaricides, insecticides-nematocides, insecticides-fungicides, nematocides, molluscides, rodenticides. These uses are in relationship with some phytosanitary problem occurring in targeted crops (Figure 2).

Among these licit chemicals, some are hazardous to human and environment, 40% are registered for use in bananas production with 28% for nematodes control alone and 10% for control of both insects and nematodes. Moreover, 20% of highly hazardous pesticides (HHP) registered are for the control of rondents. In Subsaharan Africa, registered HHP are rondenticides, insecticides and nematocides, frequently used in banana production and for protection of stored products.

Considering the specific situation of protection of stored grains from the attacks of insect pests, from 2004 to 2014, 29 active ingredients used in the formulation of more than 60 insecticides are registered and regularly used (Table 2). Among them, 6 active ingredients are obsoletes according to the WHO classification of pesticides by hazards. They are: heptahlore, lindane, chlorobenzene, endosulfan, landrin and dieldrin. Aluminium phosphide and cyflutrin are respectively in the class Ia (highly hazardous) and Ib (hazardous) of the same classifaication. These hazardous chemicals were most used from 2004 to 2013, as from 2014, the 8active ingredients are used to formulated registrated pesticides used in treatment of stored products. They belong to the classes : III (pyrimiphos methyl, mamathion), II(permethrin, deltamethrin, chlorpyriphos ethyl), Ia (aluminium phosphide) and O (lindane, heptachlore).



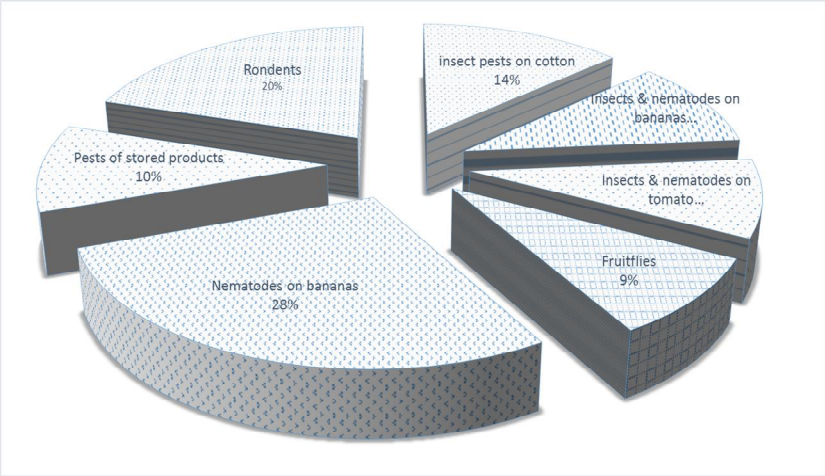


Figure 2. Pests for which Extremely hazardous and highly hazardous pesticides are registered

Table 1. List ofExtremely hazardous (Ia) andHighly hazardous(Ib) active ingredients of pesticides registered in Cameroon (1) and by the Sahelian Pesticide Committee (2).

N°	***Active ingredients** (1; 2)*	***WHO class***	***Targeted pests / Ecosystems***
1	*abamectine (1; 2)*	*Ib*	*Insects & Mites / Cotton, Fruits*
2	*bromadilone (2)*	*Ia*	*Rodents / Ware Houses*
3	*brodifacoun (1; 2)*	*Ia*	*Rodents / Ware Houses*
4	*cadusafos (2)*	*Ib*	*Insects & Nematodes/ Bananas, Tomato*
5	*ethropophos (2)*	*Ia*	*Insects & Nematodes/ Bananas, Tomato*
6	*flocoumafene (2)*	*Ia*	*Rodents / Ware Houses*
7	*oxamyl (1; 2)*	*Ib*	*Insects & Nematode / Bananas*
8	*phenamiphos (1)*	*Ib*	*Nematodes/ Bananas*
9	*aluminium phosphide (1; 2)*	*Ia*	*Insects / Stored Grains*

Table 2. Insecticides registered in Central Africa for the protection of stored cereals and used 2004 to 2015 and their status according to the classification of the JMPM FAO/OMS (2009)²

	Family*	**Active ingredient**	**Commercial name**	**Cl****	**2004**	**2007**	**2011**	**2013**	**2014**	**2015**
1	*OP*	*pyrimiphos methyl*	ACTELICT ACTALM SUPER, PROTECT DP	*III*						
2	*Pyr*	*cypermethrin*	CYPERCAL ; CIGOGNE ; CYGA ; CYPALM	*II*						
3	*OC*	*chlorobenzene*	HCH (POUDRE BLANCHE) CAMPHOR	*O*						
4	*OP*	*malathion*	POUDROX, FYFANON 880EC	*III*						
5	*Pyr*	*permethrine*	ANTOUKA SUPER, PERCAL	*II*						
6	*OC*	*lindane*	TERMITOX, POUDRE ROUGE SODECOTON	*O*						
7	*OP*	*profenofos*	CALFOS ; CALIFE ; CALLIX, PROFENALM	*II*						
8	*Neonico*	*acetamipride*	BENJI; OPTIMAL MATADOR ; KRISS	*III*						
9	*Carb*	*indoxacarb*	AVAUNT; STEWART	*II*						
10	*OP*	*thiodicarb*	ALTERNAX	*II*						
11	*Pyr*	*lamda-cyhalothrine*	LAMDACAL 100EC	*II*						
12	*Carb*	*triazophos*	TRIALM 400EC ; TRIAZOFORCE 400EC	*Ib*						
13	*OC*	*endosulfan (+thirame)*	CALTIO E; SULTAN ; THIONEX, THIODAN	*O*						
14	*OP*	*dichlorvos*	DD FORCE ; PEST OFF	*Ib*						
15	*Carb*	*carbosulfan*	MARSHALL ; GÉNÉRAL	*II*						
16	*OC*	*heptachlore*	THIORAL	*O*						
17	*Pyr*	*Deltametrine*	MALAGRAIN SUPER ; STARGRAIN 2 DP KO BIOL	*II*						
18	*OC*	*dieldrine*	DIELDREX DIELDRINE	*O*						
19	*Carb*	*benfuracarb*	ONCOL	*II*						
20	*OC*	*landrine*	LANDRINE	*O*						
21	*Neonico*	*imidaclopride + thirame*	INSECTART ; MONTAZ 45WS	*II*						
22	*OP*	*propoxur*	PROPALM 2 DP	*II*						
23	*Pyr*	*cypermetrine+profenofos*	CYPERCAL	*II*						
24	*OP*	*chlopyrifos-ethyl+ thirame*	CALTHIO C	*II*						
25	*Carb*	*carbofuran*	WORMFORCE	*Ib*						
26	*OP*	*fenitrothion*	FENICAL	*II*						
27	*IGR*	*emamectine benzoate*	CAÏMAN B	*III*						
28	*Pyr*	*cyflutrine*	ACTALM SUPER	*Ib*						
29	*FM*	*phosphure d'aluminium*	ALADIN ; PHOSPHINION ; PHOSTOXIN, JUSTOXIN CELPHOS ; CYCLONE	*Ia*						

* OP : organo phosphorous ; OC : organo chlorinated ;Pyr : pyrethrinoid ; Carb : carbamates; Fum : fimigant.
** Classification of OMS (JM FAO- WHO, 2009) : class Ia= Extremely hazardous; Ib = Highly hazardous ; class II = Moderately hazardous ; class III = Slightly hazardous

Table 3. Active ingredients and commercial names of alternative pesticides registered in Central and West Africa with their toxicological classes and their targeted pests

Active ingredients			*Class*	*Targeted pests / Ecosystem*	*Registered formulations*
West Africa (CSP)	*1*	*Bacillus thuringiensis*	*III*	*mousquito / indoor*	*BAVITECK*
				caterpilars / sprouts	*BATIK WG*
	2	*spinosad*	*III*	*Insect pests / tomato farm*	*LASER 480 SC*
				Insects / stored products&human foods	*SPINTOR POUDRE 1,25*
				Fruits flies / mango	*SUCCES APPAT*
	3	*azadirachtin*	*III*	*Insect pests / cotton*	*SUNEEM 1,1%EC*
Central Africa (Cameroon)	*1*	*gibberelin A3 40%*	*III*	*Post-harvest ripening regulator / fruits*	*RYZUP 40SG*

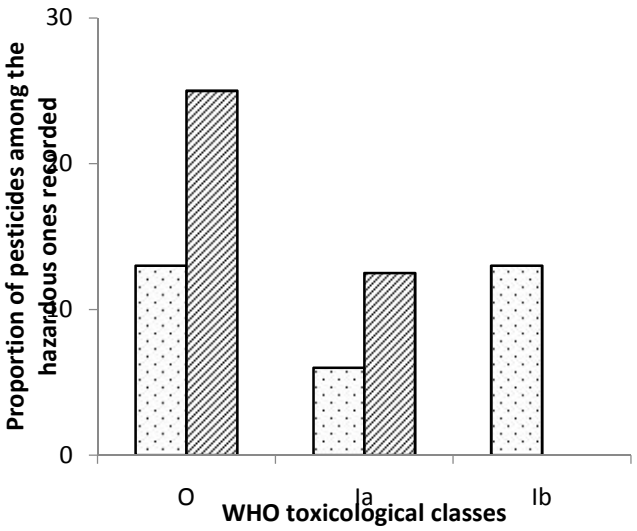


Figure 3. Numerical importance of dangerous registered pesticides by WHO toxicological classes (Ia= Extremely hazardous; Ib = Highly hazardous and O : obsoletes) during the years 2011 [¨] and 2015 [///]

Licit POP (heptachlore, chlorobenzène) and HHP (alluminium phosphide, terbufos, abamectine, ethropophos, …) are frequently used to protect stored grains. In cotton production, lindane and HCH are used.

Some advances these recent years pointed out the registration of some moderately and slightly hazardous pesticides as alternatives to the extremely and highly hazardous pesticides available (Table 3). Implementation of this change in the dependance on hazardous pesticides is most important in West African than it is the case in Central Africa. The Sahelian Committee of Pesticides registered till date 3 major biopesticides producted from the formulation of natural active ingredients. In Central Africa, especially in Cameroon, only one in registered;

IV.CONCLUSION

Investigations presented in the present work are illustrations of the evolution of the use of pesticides in agriculture during the last 10 years in Sub-Saharan Africa. A positive change in the better use of pesticides quality in the crop protection is on its way but some improvements are expected. A very poor post regulation survey is made, as consequence the amount of pesticides counterfeit and the general mismanagement of stocks is frequent. Moreover, the development and registration of biopesticides is to be enhanced by all stakeholders.Slightly hazardous pesticides as alternatives tools are progressively occurring on markets.

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