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Pesticides Empty Containers (EPC) in the Area of Ouagadougou: Actors, Risks and Prospects of Secure Management

Gomgnimbou P.K Alain¹ and Ouédraogo W. Osée²

¹INERA Station de Recherche de Farako-Bâ, Bobo-Dioulasso

²DRECV/Hauts bassin, Bobo-Dioulasso
Burkina Faso

1. Introduction

The use of the pesticides knew since the middle of last century a considerable expansion in the developed countries but also in those of the Third World for the treatments improvement of the cultures of export and subsistence (Ramade, 2008). According to International Fertilizer Development Center (IFDC) (2004) Burkina Faso consumes chemical inputs more and more. Indeed, the concern of increasing the agricultural outputs leads the producers to the generalized use of the pesticides for the control of the parasitic attacks on the cultures and the weeding of the Also, the pesticides according to their chemical formulation have other uses in particular in maintenance of the gardens, conservation of the foodstuffs, the cleaning of swimming pools etc. However, this practice is not without detrimental consequence on the biophysics environment and populations (FAO, 1996; Traoré & Toé, 2008; Assogba-Komlan and al, 2007). The residues of the pesticides can be found in the cow's milk, in fish, in the ground and cashew nut (Ramesh & Vijayalakshmi, 2002). One of the important aspects in the process of dissemination of the pesticides and their residues in the ecosystems are empty pesticide containers (EPC). This aspect has a very little attention in our country, yet also a diagnosis of this activity reveals a number of risks on the environment and human populations are exposed.

Indeed, some studies have shown that empty containers including vials are commonly used by farmers for repackaging food (IFDC, 2004). According to several authors (Whitford and al. 2006; Nesheim & Fishel, 2005; Bliefert & Perraud, 2008), empty containers of pesticides are toxic and hazardous waste and must be collected as all other waste and eliminated in healthy and rational environment.

It appears that the management of empty pesticide containers must constitute a concern for governments but also for all actors of the development. The contamination of environmental matrices is related to the ability to rationally manage these packages. It is, therefore, appropriate to characterize these actors, the modes of management of empty containers, the ecological evaluation of the risks and to seek opportunities to manage safely these empty packages. It is the objective through this study in the area of Ouagadougou.

2. Methodological approach

2.1. Presentation of the study area

2.1.1 Location of study area

Ouagadougou (Map 1) is the capital of the province of Kadiogo which is located in the heart of Burkina Faso. Its area is 2826.28 km². Ouagadougou also located in the Sudano-Sahelian area.



Map 1. Location of the area study

2.1.2 Biophysical setting

Climate: Ouagadougou, the capital of the Province of Kadiogo, is characterized by a tropical climate with two main seasons: the rainy season and the dry season. The first one (from May to October) is marked by the moist winds of the monsoon. The water depth rarely exceeds 700 mm per year. The month of August is the wettest. The second one, the dry season, is longer (from October to May) and is dominated by the Harmattan winds. Regarding temperatures, they vary between 22 ° and 35 ° minimum of maxima.

Soils: they are essentially tropical ferruginous laterite type and clay resting on a large mass of granite cracked. There are four classes of soil which are raw mineral soils or lithosols, the poorly evolved brown surface and greyish-brown or pale in depth, the soil leached ferruginous tropical and the soils leached tropical ferruginous brown-modal pale brown near the surface and brown brilliant in depth.

Vegetation: The canopy is the most dominant shrub savannah dotted with clear large trees and an herbaceous layer. At the level of the alluvial terraces and along the main drainage,

there is rock vegetation. This vegetation consists mainly of medium-sized trees (Shea, locust, and baobab) shrubs, especially thorny grass, part of which is widely used in the manufacture of straw (roof boxes, attics or sheds, etc.). This vegetation is sparse due to its intense exploitation for domestic needs, craft and construction. Along seasonal rivers developed savanna woodland.

Relief: it is low penepplain type (300 to 400 meters) from the sea level and characterized by plateaus emerged in places where battleships mounds or ridges armored dismantled and often convex shape (plate) ; axes that constitute the drainage Massili (a branch of Nakambé or White Volta) and its many offshoots; glazes battleships inserted between the plates and the relatively high drainage axes.).

2.2 Selection of actors

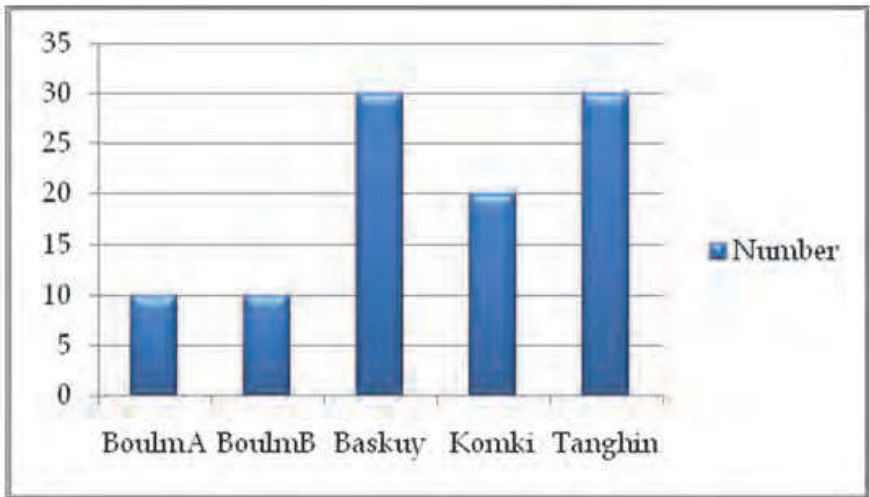
For data collection, a sample of actors was identified by taking into account all the links in the chain of pesticide management. This was:

- i. Manufacturing companies and distribution of pesticides
- ii. Traders and shopkeepers and sellers of pesticides (Table 1)
- iii. Farmers (vegetables, rice, floriculture) using pesticides within a radius of 45 km from Ouagadougou (Figure 1)

For each type of actors a questionnaire was applied and the questions were related to supplies, the types of molecules sold, the management mode of empty packaging, the perception of risks, the prospects for secure management.

Zone	Market 1 (Sankariaré, Ouidi)	Market 2 (Baskuy)	Market 3 (Théâtre Populaire)	Peripheral zone (45km from Ouagadougou)	TOTAL
Number	07	10	11	17	45

Table 1. Distributors surveyed by zone



BoulmA: Gardeners of Boulmiougou zone A; sector 17

BoulmB : Gardeners of Boulmiougou zone B; sector 17

Baskuy : Gardeners of sector 19

Komki : Komki-ipala

Graph 1. Farmers surveyed per site

2.3 Parameters evaluation

In order to appreciate the level of ecological risk, a grid was elaborated. It gives the knowledge standard of the different actors (traders; distributors; farmers) about the risk linked to the management of the Empty Pesticides Containers (EPC).

Actors	Level of appreciation		
	satisfying	insufficient	very insufficient
-Distributors -Gardeners -Rice producers -Floriculters	- To protect itself with the Individual Protection Equipments (IPE) - To rinse the EPC - To apply flushing waters to the culture - To perforate and store far from the dwellings - To hide in an adequate pit - To burn in an adapted incinerator	- To protect the Individual Protection Equipments (IPE) - To burn in a vat or a pit	- To burn in the free air - To give up in the refuse vats - To throw in the absorbing wells or any pit.

Table 2. Matrix of the actor’s knowledge assessment

3. Dynamic EPC of actors

3.1 Distributors

3.1.1 General characteristics

The findings on the profile of the distributors are recorded in the graph 2. They reveal that the distribution of the pesticides is done through wholesalers and retailers who have more or less shops. About 72% of the investigated distributors are organized either associations or cooperatives.

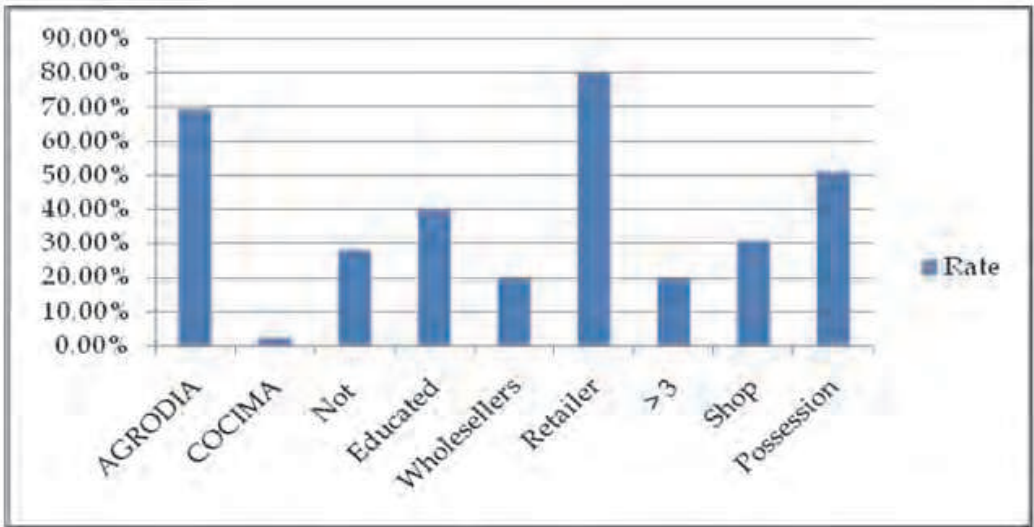
This organizational structure will help, in one hand, to have a hierarchy in the responsibilities and in the other hand, to organize very well the branch (department) of the integrated management of the EPC.

Few distributors were provided with schooling. It means that they have not even the primary school level (only 40% have utterly secondary school level). The diversity of the education standard will allow choosing well some approaches for a better comprehension of the possible formations that they have to receive for the development of their professional skills.

The findings on the size and the state of the warehouse (Wholesalers or retailers, number of the employee superior to 3; shops well structured in its different branches) allow to target very well the proportion of the shop which would possibly do the collect of the EPC and to transport them toward a possible centre of decontamination.

Moreover, 51.12% of distributors admit they have a professional approval. Basing our argument on the *decree, 98/481 about the consents to operators of the commerce, the industry and handcraft department (1998)* all distributors should possess consent in order to prove their

ability to advise the pesticides buyers about the agricultural good practices and especially about the risk linked to the empty containers.

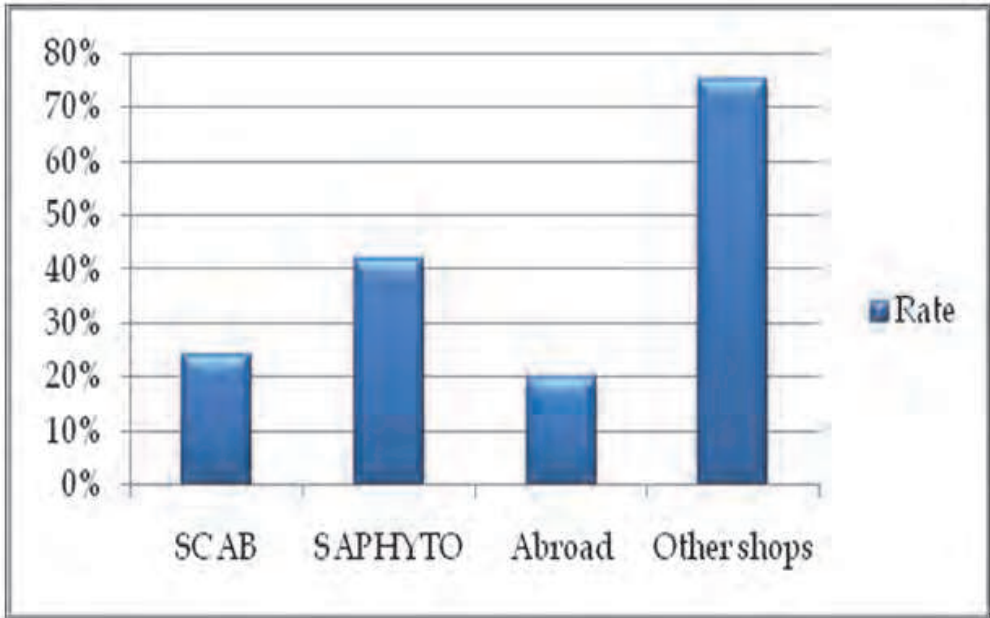


AGRODIA (Pesticides salesmen Association) = member of AGRODIA; **COCIMA** (Pesticides salesmen cooperative)= member of COCIM; Non= Not adhering to an association or cooperative;. Whole sellers = who sells with retailers and OPA (Organization of Agricultural professionals); Shop= Structured different positions (administrative, inventory management, sales); >3=Shops that employ more than 3 workers.

Graph 2. Profile of surveyed distributors

3.1.2 Pesticides supply channels

Generally speaking, the farmers’ pesticides supplying sources are the manufacturing firm (SCAB, SAPHYTO); abroad industries and other shops of Ouagadougou. The graph 3 summarizes the contributive share of each supply channel.



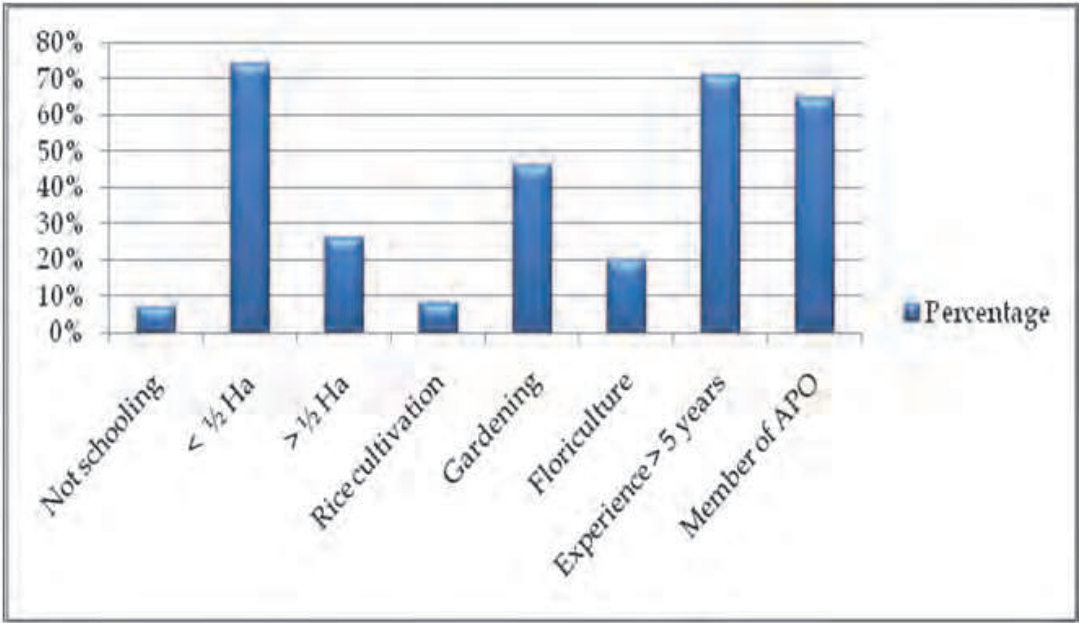
Graph 3. Supply channels of pesticides

The majority of wholesalers (Talata Agrochen ; King Agro; EKF; Ets Bonou etc.) stock up with the great pesticides societies of Burkina (SAPHYTO, SCAB) or abroad (Côte d’Ivoire; Ghana; Togo; Benin etc.).

Most of the wholesalers which stock up with Saphyto do so for the quality of the products and confidence reasons. The findings show that the channels are very dynamic. Indeed, the inputs are the subject of a particular attention as the bargain and the prices become autonomous. So, this entails a multiplication of the actors, the products; the supply sources and of the distribution channels what is more and more difficult to apprehend. The knowledge of these findings identifies the main suppliers and should make easier the relation supplier-distributor for the research of the collective solutions to manage the EPC.

3.2 Producers

The identified agricultural producers were rice-producing gardeners; flower-gardeners. Their profile is given in graph 4.



Graph 4. Famers surveyed profile

The graph 4 shows a very low schooling standard (7%) which is directly linked with the finding about the knowledge of the methods to lessen the risks. The knowledge about the schooling and the experience levels will allow choosing well the approaches to train those producers about the risks of the EPC in order to develop their competences and to professionalize the agricultural department. We must note that the need of a regular and adapted training is justified.

The finding got about the cultivable areas (few gardeners have more than ½ ha) gives information on the repackaging to offer a packing adapted to small areas.

It will allow fixing some other ambitions to extend the study to the regions where the use will be significant in order to see many details about the risks linked to EPC management method.

It emerges from this graph that the sample did not concern the cotton producers for time and logistic reasons. Moreover, we must note that during the observations of the containers on the agricultural areas, many pesticides containers authorized for cotton and not

authorized for market gardening were seen. These pesticides are essentially composed of ROCKY 500 EC and ROCKY 386 EC both having as active raw material endosulfan. They are also composed of FANGA 500 EC having as active raw material profenofos. That shows that the gardeners use some inappropriate and non-authorized pesticides in gardening. These risked practices are already bought to the fore by ODEPAB (2006). At this stage also, the training need, regulations enforcement and the adapted pesticides supplying for gardening are justified.

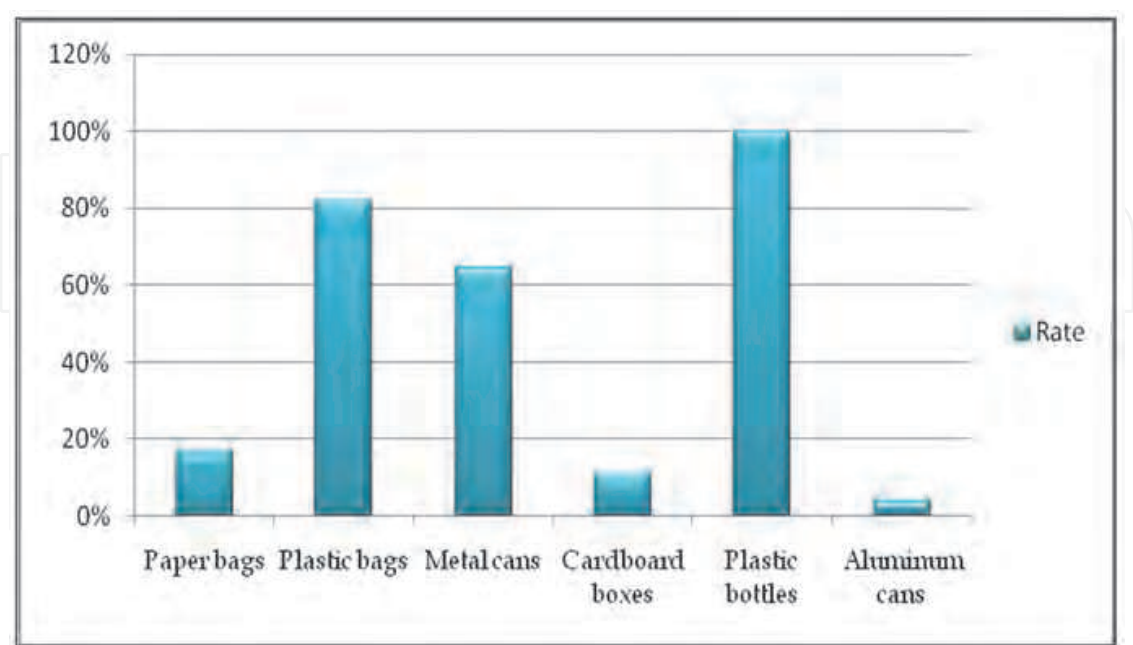
Therefore, 65% of the investigated producers are members of an APO. It represents an advantage for a good organization of the EPC management. Indeed, it will be easier to intervene with a producer who is member of an APO than with one who is not member. It will be also a trump to organize well the training sessions about the risks caused by the pesticides, generally speaking, and especially about the empty packing.

4. EPC management by the actors

4.1 To the suppliers
4.1.1 The types of packing which are in shops

The main wrappings in supplier’s shops are plastic cans of which type is the one in PHD (polyethylene high density) in relation to PET (Polyethylene terphthalates); the plastic bags (of which the aluminum covers the internal part) and metallic boxes (graph 5). The proportions of these types of wrapping seen in the shops are liable to be found anarchically in the water and the soil after use.

In one hand, the findings will allow to have an idea about the existing EPC and then to think about how to manage the wrapping once empty. We do not use the same way to manage a metallic box and PEHD can or PET; in the other hand, the findings will allow having a credibility of information about repackaging. We can say to exaggerate that the type of wrapping which in shops are the same ones than those seen to the customers.

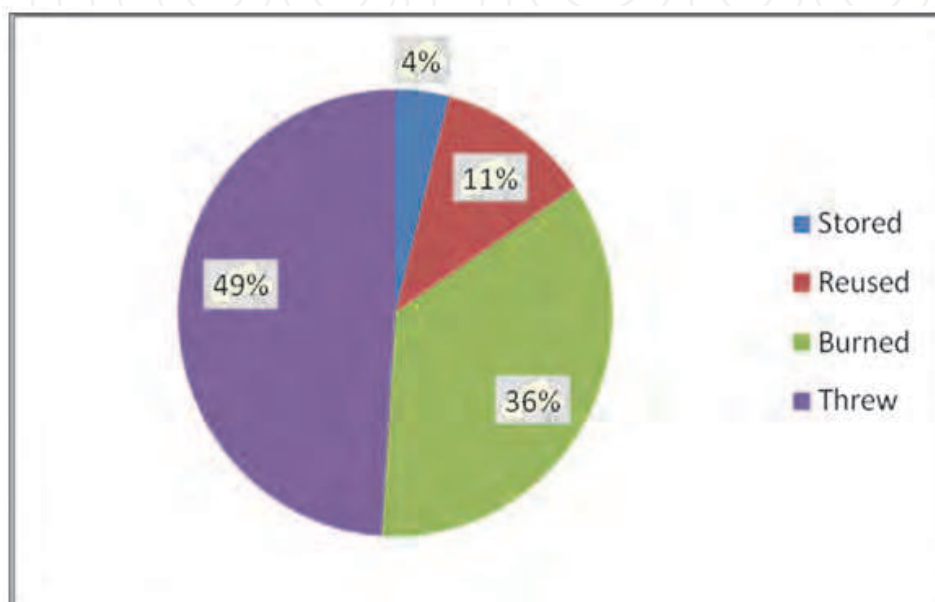


Graph 5. Packaging type found in the shops

4.1.2 Suppliers way of managing the EPC

To respond to the expectations, many suppliers choose the repackaging of the pesticides. It emerges from the findings of the investigation that 52% of the suppliers repack pesticides in their own workshops. The repackaging is not very explicit in the national decree but it is against the international law of behavior about the supply and the use of pesticides. Nevertheless, the FAO code should be applied in that case. The Article 10 of that code clearly specifies that “the governments must take the measures conforming to the necessary regulation to forbid the repackaging etc.”

Talking about the way to manage the EPC after repackaging, it is shown in graph 6.



Graph 6. EPC management by distributors

It emerges from this graph that the abandoning seems to be a common practice. That behavior is practiced by about 49% of suppliers. The supplier's category (36%) has chosen to burn EPC.

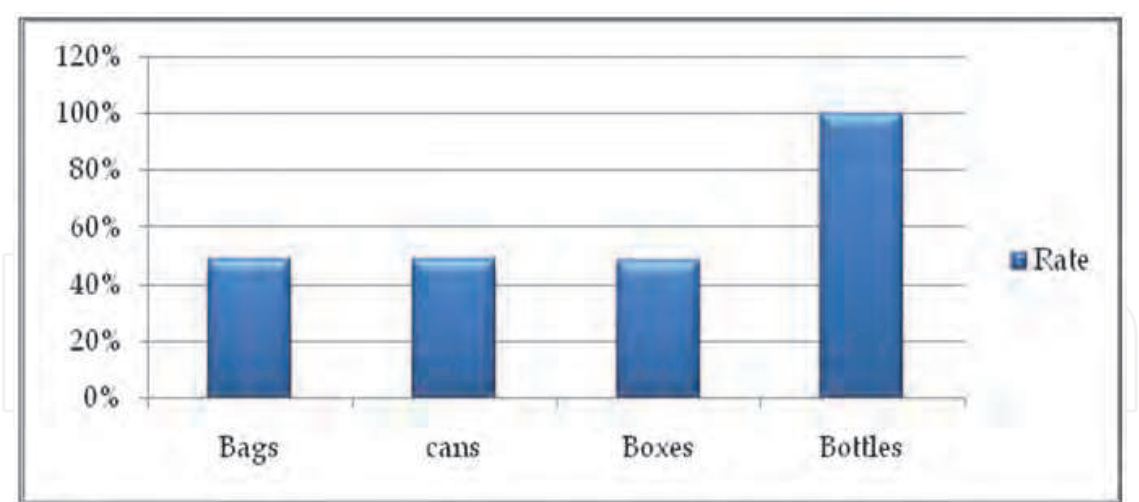
-Mode of repackaging the liquid products: Generally speaking, the suppliers have some wrappings which initially were in one liter cans; half a liter cans and in cans of 200 ml to 250ml. The process of repackaging ends up at products contained in 10-100ml little bottles sold at 250 or 300frcs. This shows that the official wrappings are not adapted in cost and in volume to the producer. These two elements oblige both producer and supplier to repackage unlawfully to have benefit. This practice is adopted by all the sales assistants of the outlying areas so be it 38% of the 45 investigated suppliers.

-Mode of repackaging powder products: Initially, the suppliers possess powder products in ½ Kg or 1kg plastic bags packing and in 25-50kg bags. At the end of the repackaging, some 10-100g bags are sold from 50 to 500frcs. 80% of the retailers do this practice.

4.2 To the producers

4.2.1 Type of packing used by producers

Almost half of the interviewed producers use pesticide in plastic cans of 500ml to 1000ml(49%) and pesticide packing in metallic boxes of 200-250ml(48%), in addition to the little glass bottles of 10-100ml(100%) as showed in the graph 7.

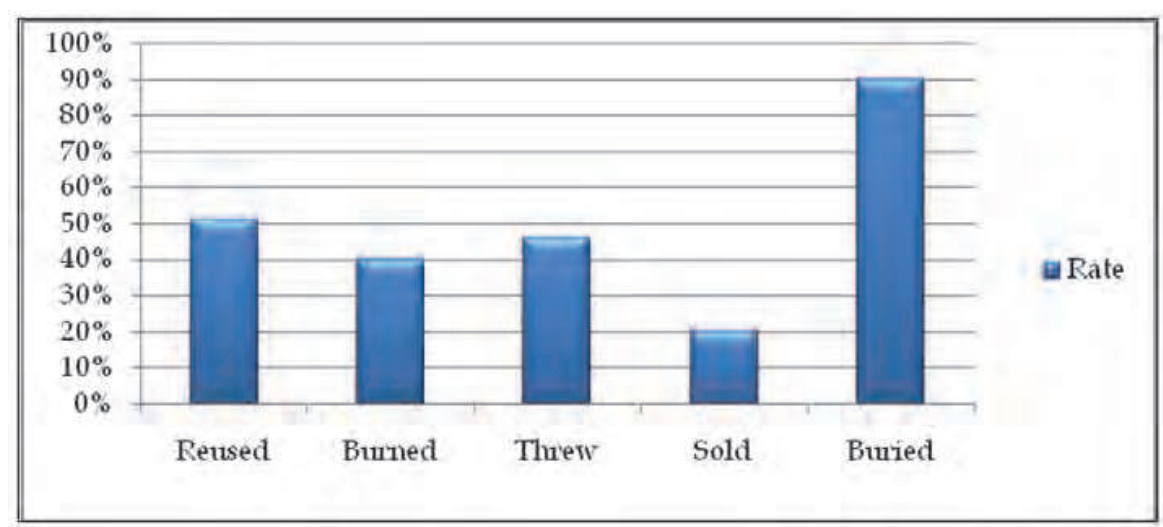


Graph 7. Packaging type found among famers

We noted an absence of glass bottles at the level of packing pesticide sold by suppliers. We can conclude that these bottles come from the practices of repackaging by non-investigated structures (suppliers or agricultural producers).

4.2.2 Mode of managing EPC by agricultural producers

The mode of the managing EPC by the producers follows five options according the graph 8.



Graph 8. Mode of managing EPC by the agricultural producers

We can read the graph 8 as follows:

- 51% of the agricultural producers say they use again wrapping for food purposes.
- 40% of producers opt systemically or occasionally for burning at the open air. This practice is totally different of a burning done in an appropriate system (such as a farm incinerator).
- 46% of the producers prefer to throw or to abandon EPC in the living areas or in lost empty wells.
- 20% of the producers resell systematically or occasionally the empty packing in order to favor repackaging.
- 90% of the producers partially bury the packing in the fields or in living areas.

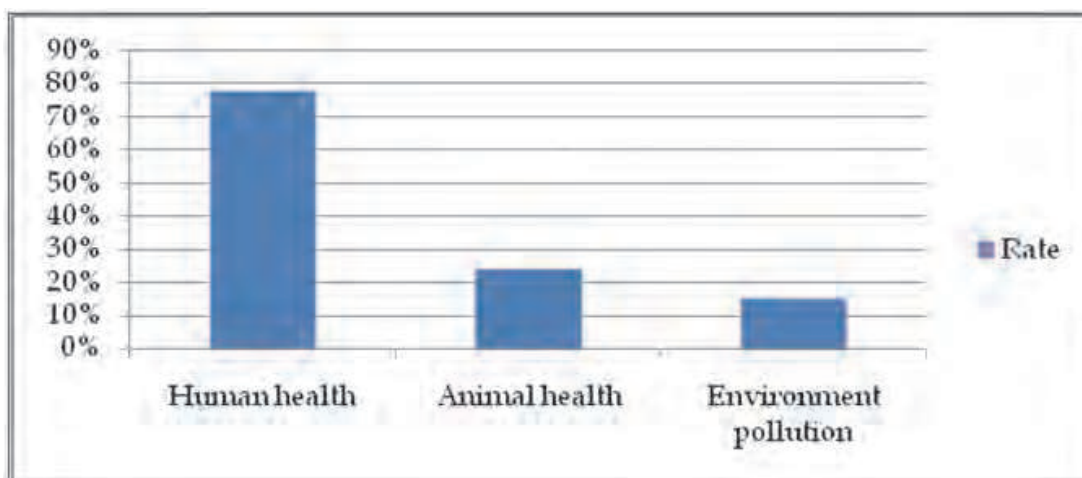
These pieces of information show that an ecological and safety management to give a sense of security is not reassured. The different modes of managing for a better elimination (re-use; burning; open air throwing; sales; anarchic burying) are non-rational methods. These mentioned forms of management are already emphasized (FAO, 1996; IFDC, 2004) especially in cotton agro systems and generally speaking in agricultural areas.

5. Knowledge of the environmental problems

5.1 How the suppliers perceive environmental problems

5.1.1 Knowledge of the risks sources

It is fundamental to perceive the risks caused by an irrational management of the EPC on the environmental matrices in order to establish some processes to reduce the risks. The standard knowledge is shown in graph 9.



Graph 9. Risk perception by distributors

A large majority of distributors (78% of the cases) know that EPC can have some risks on human health. The major part of this group gives a precision about a feasible poisoning by breathing or orally. But few distributors think about skin poisoning.

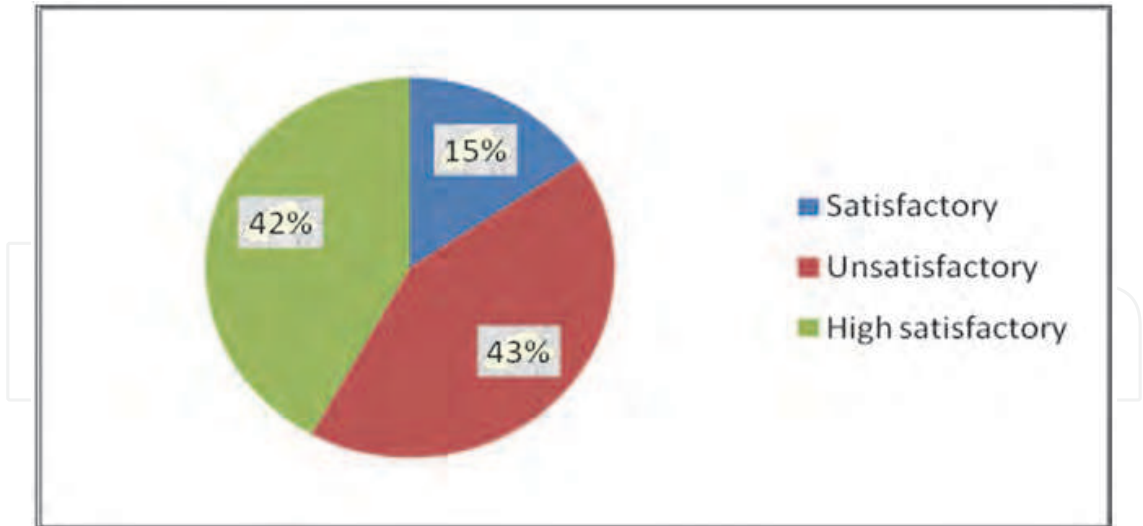
As they are not directly confronted to the constraints of applying pesticides in the fields, the distributors do not think a lot about the risks of pesticides on animals (named by only 45% of the distributors) and on environment, meaning water, the soil and the air.

5.1.2 Knowledge standard about the means to mitigate the effects of pesticides

The distributors' knowledge standard about the means to mitigate the effects of pesticides on environment is shown in graph 10.

We remark a low rate of distributors who have satisfactory knowledge about EPC management (only 15% of them). This finding confronts the one of those who say they have a professional consent (51,12%). The consent is not attributed only if the professional competences are judged satisfying. Besides, the knowledge of the effects mitigation measures would be one of the conditions to have an approval.

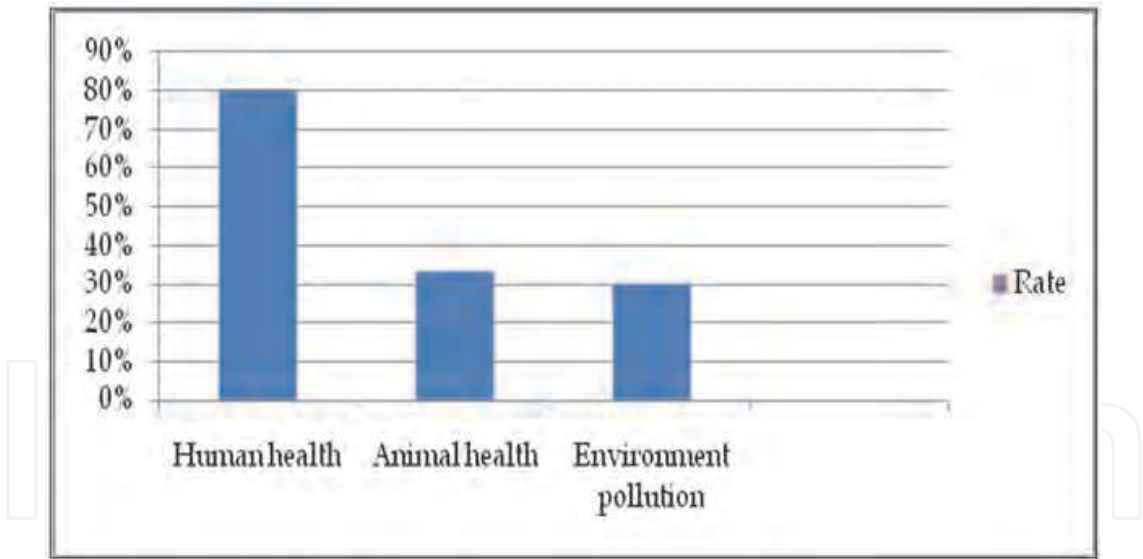
This finding will allow seeing that there is a need of vocational training and information regularly and adapted to the distributors. The conditions of granting the consent to those who want to sell pesticides should be reviewed.



Graph 10. Distributors finding on mitigation

5.2 Producers knowledge about environmental problems
5.2.1 Knowledge of the risks sources

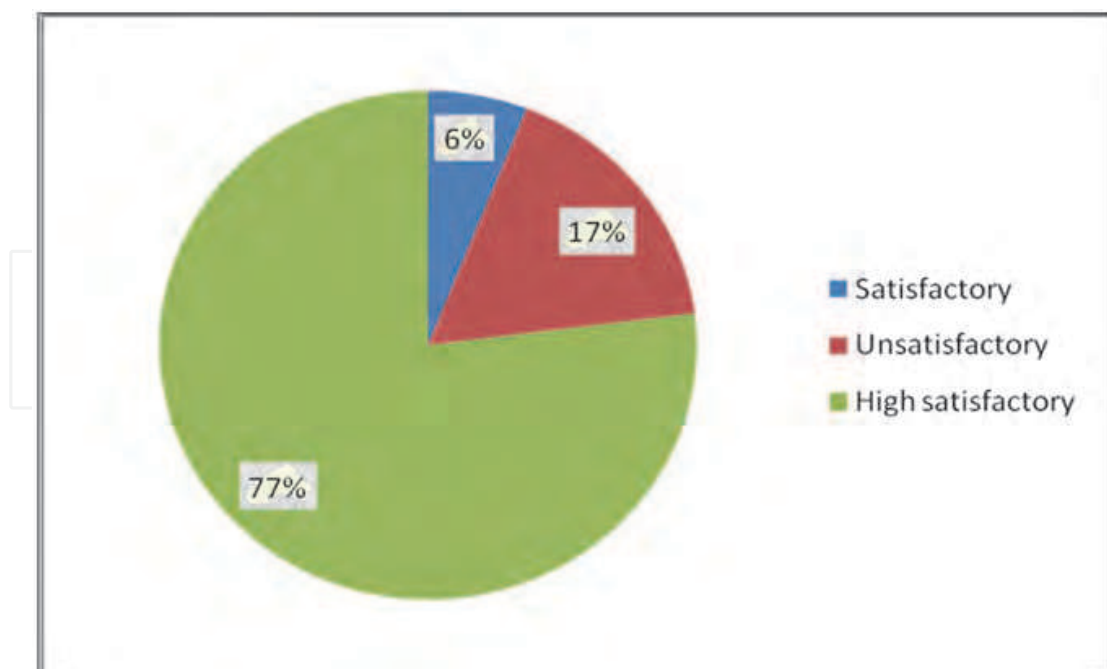
A great number of producers are aware of the risks on human health. Contrary to distributors (see graph8) producers perceive well the risks on animal health and about environmental pollution. This situation is shown in graph 11.



Graph 11. Consciousness of the risk generated by EPC

5.2.2 Knowledge about the measures to mitigate the effects

The measures to mitigate the effects used by the producers were evaluated. Graph 12 sums up the level of knowledge of these measures known by the agricultural producers. The findings show that 77% of the producers have a very insufficient knowledge about the measures to lessen the effects. This percentage must attract the persons in charge of the APO attention so that they can invest themselves in the vocational training and in the sensibilisation of their members.



Graph 12. Mitigation knowledge by agricultural producers

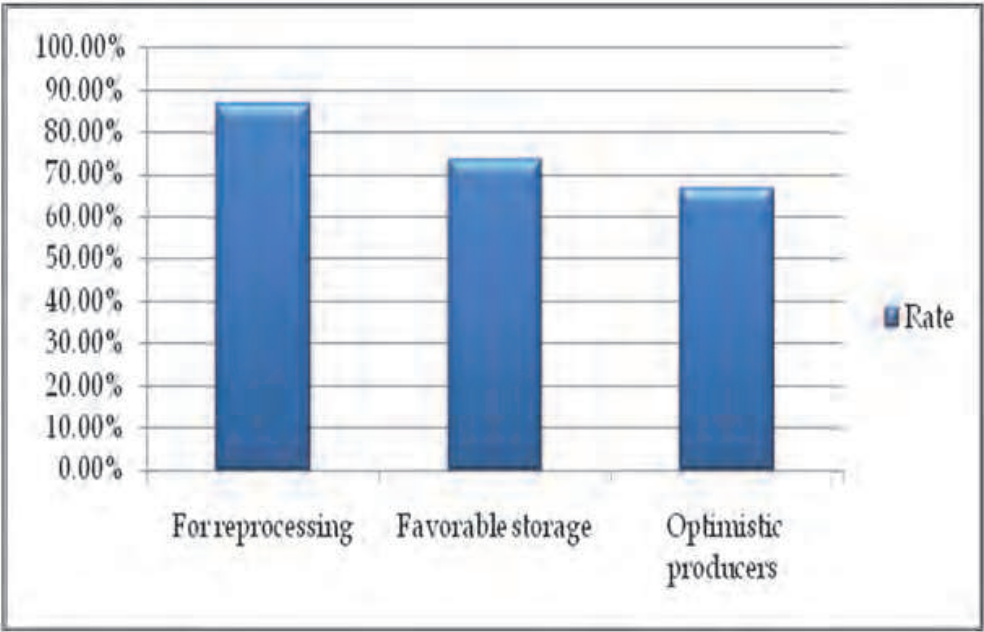
In this connection, the findings are the same as those obtained by the Benin Organization For The Promotion Of the Organic Agriculture (ODEPAB)(2006).Likewise, the salvation for reprocessing of the empty wrapping is and will remain the difficult work as long as it will be done with some skills and practices behavior. Indeed, in actual practice, our rural populations have a very limited view about the incurred risks through the use of the wrapping. No sensibilisation can convince them that there is a risk of using this or that poisonous wrapping. But it is when they are in front of a concrete case of poisoning that they are convincing now. A peulh point of view is that the plastic cans of 1-20l can be replaced with cucurbitaceous beaker and cancel some constraints due to transport, foods preservation such as milk and butter. Travelers and farmers value 4-20l plastic cans covered by basin fiber as the best means of cold water conservator than goatskin used in the past.

From the point of view of the real knowledge of our populations (rural population as well as urban one) about the used pesticides and their socio-cultural practices, the presence of these non-recovered wrapping constitutes effectively a threat for human health especially when a low rate of salvation of reprocessing comes to add to some factors such as the mode of management and the storing sites which are essentially located in cattle farm and agricultural areas (IFDC, 2004).

6. Prospects of the EPC management

6.1 Distributors' opinion

The risks due to the EPC and the measures to mitigate the effects mentioned by the distributors and the agricultural producers direct the reflexion to find the means and ways to manage the EPC. Some means were prospected for the distributors (graph 12).It is to institute a system of EPC reprocessing, of collect and of storage. This system aim is also to motivate all the members.



Graph 12. Distributors strategy for EPC managing

Moreover, the distributors propose some responsibilities to the different actors in other to insure a good management of the EPC. The propositions to attribute the responsibilities to all the actors are mentioned as follows:

The government: to install a unit to value the EPC in Ouagadougou; to install some compartments not far from each distributors to collect the EPC; to entrust to the concerned actors the management (production firms; suppliers; distributors; agricultural producers) with their respective different professional organizations (AGRODIA; FEPAB)

AGRODIA: to train and to sensitize the distributors about the risks caused by the EPC; to seek financiers to insure well the EPC salvaging for reprocessing.

The distributors: to accept to store temporarily the EPC and to motivate the agricultural producers who are costumers to give back the EPC after using; to advise the agricultural producers about the risks caused by the EPC and about the measures to mitigate the effects.

The producers: to accept to store temporarily the EPC and to give back the EPC to the pesticides distributors units.

6.2 Producers' opinion

Convinced of the necessity to manage rationally the EPC, the agricultural producers have made the following propositions:

All of them are for a collection department of the EPC: 100% of the cases.

Some propose to review the pesticides packing manufacturing: 33% of the cases.

80% are optimistic about a good working of the EPC integrated management department.

All the producers think there is a lack of training about the EPC management. So, they think the responsibility returns to the responsables of their Unions, Cooperatives and Organizations and especially to the FEPAB.

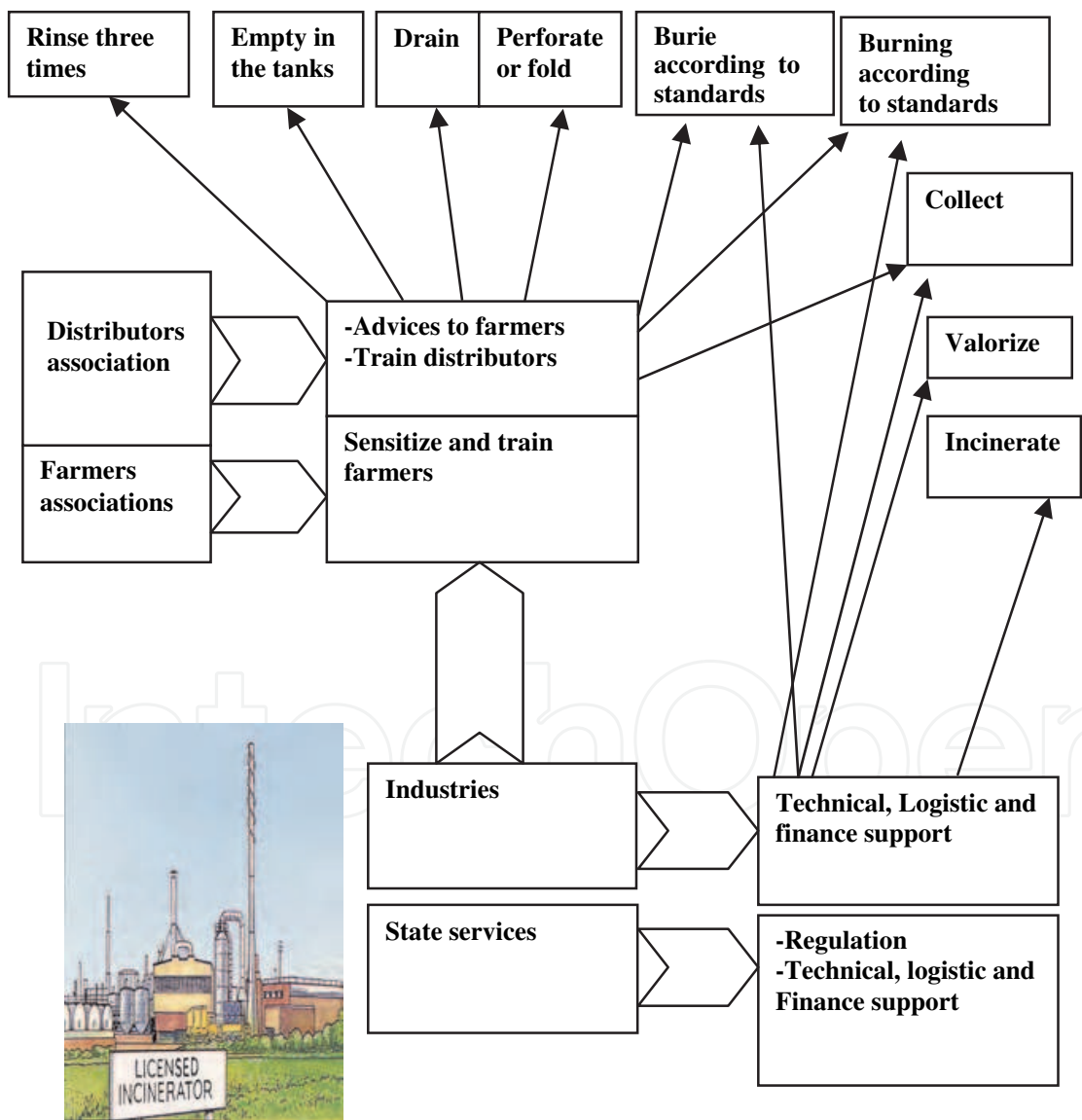
For the producers, AGRODIA should encourage its members by a motivation to collect the EPC.

For the majority of the interviewed producers, the government must demand the EPC to the distributors.

According to 100% of the interviewed producers, the pesticides salesmen must take back the EPC by giving a little discount on the sold products or by giving a free gift of product to some who give back the EPC.

6.3 The ways for a lastable management of the EPC

Given the issues raised concerning the management of the EPC, the diversity of actors involved in the pesticides domain, we urge all of those who are concerned to show a considerable interest about this topic. We propose the following scheme 1 that helps to position the various stakeholders, both technical and organizational domains. This scheme responding to a goal of our study also aims to bring together all the actors involved directly or indirectly in the management of the EPC; pushed for an exchange through workshops, seminars, conferences etc.; to install an official organization for the management of the EPC.



Scheme 1. Actors organization for EPC secure and sustainable management

7. Conclusion

This study has allowed emphasizing the actors, the risks and the prospects for the EPC management to give a sense of security. The actors are varied and come down to the firms, the distributors who are salesmen at the same time and the agricultural producers (market gardeners, paddy field farmers, flower gardeners). We will retain that in Ouagadougou area, the main sources of pesticides supplying are the distributors (SCAB, SAPHYTO), abroad firms, the shops in the markets. The dreaded risks are related to population poisoning, the ecological matrices contamination (water, soil). They are closely linked to the EPC management and elimination practices. These practices come down to the distributors and the agricultural producers as follows:

- The pesticides over packing stored with foods;
- The use of some new types of packing for the pesticides reprocessing;
- The storage of the empty packing on the shop counter after the reprocessing;
- The re-use of the cans by the salesmen for alimentary purposes (especially for drinking water);
- The anarchic abandoning of the empty packing behind the residences walls at the edge of the roads;
- The anarchic abandoning of the empty packing in the fields or in the houses by the producers;
- The burying of the empty packing in the water wells (wells and dams which are not lay out) by the producers and the distributors;
- The storage of empty packing at the children reaches under the fields' trees by the producers;
- The re-use for alimentary purposes, the throw in the living areas or in some lost wells;
- The open air burning.

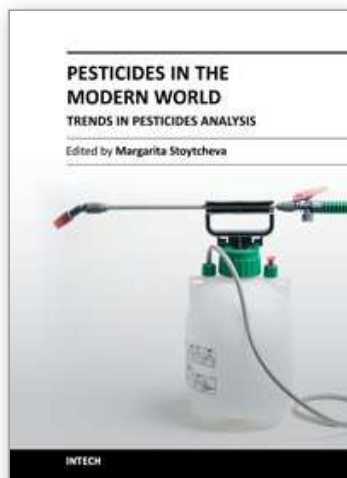
Moreover, some factors such as the schooling level of the actors, a good knowledge about the risks and the disponibility of the actors constitute some ways to be prospected for the EPC elimination. All these mentioned factors are determinant for the elaboration and the carrying out of a rational EPC management project. Considering these relative concerns, it is urgent to plan an intensive campaign to inform-sensitize the administrative responsible, the distributors, the farmers and the whole populations about the dangers and the risks linked to the use of the pesticides and the EPC.

8. References

- Assogba-Komlan, F. ; Anihouvi, P. ; Achigan, E. ; Sikirou, R. ; Boko, A. ; Adje C. ; Ahle, V. ; Vodouhe, R. ; Assa, A. (2007). Pratiques culturelles et teneur en éléments anti nutritionnels (nitrates et pesticides) du *Solanum macrocarpum* au sud du Bénin. *African Journal of Food Agriculture Nutrition and Development*, Vol. 7, No. 4, 2007.
- Bliefert C & Perraud R. (2008). Chimie de l'environnement : air, eau, sols, déchets. Edition De Boeck : Bruxelles. ISBN 978-2-8041-5945-0. 478p
- FAO (1996). Prévention de l'accumulation de stocks de pesticides périmés. Directives provisoires. Collection FAO : Rome, 36p.
- IFDC (Centre International pour la Fertilité des Sols et le Développement Agricole) (2004). Le marché des intrants au Mali, Burkina et Ghana. Document de travail, IFDC, 103 pages.

- MCIA (1998). Décret 98/481/PRES/PM/MCIA/ AGRI du 09 décembre 98 fixant conditions de délivrance de l'agrément pour l'importation, la vente, la mise en vente, la détention, la distribution à titre gratuit ou les prestations de service portant sur les pesticides.
- Nesheim, O.N & Fishel, F.M.(2005). Prosper disposal waste pesticides. UF/IFAS, 11p.
- OBEPAB (Organisation Béninoise pour la Promotion de l'Agriculture Biologique). (2006). Identification des problèmes sanitaires et environnementaux liés aux Pops. Rapport d'étude. IPEP. (Avril 2006). 42p.
- Ramade, F. (2009). Elément d'écologie: écologie fondamentale. Edition Dunod:Paris ISBN 978-10-0530008-3, 690p.
- Ramade, F. (2008). Introduction à l'écotoxicologie. Edition TEC &DOC(Lavoisier): Paris, ISBN 978-2-7430-0944-1, 609p.
- PAN Africa (2005). Utilisation et gestion des pesticides dans la lutte anti-acridienne de 2004-2005 au Mali. Rapport n°9/ASP/(avril 2006).63p
- Ramesh A & Vijayalakshmi A. (2002). Environmental exposure to residues after aerial spraying of endosulfan: residues in cow milk, fish, soil and cashew leaf in Kasargode, Kerala, India. Pest Manag Sci 58:1048-1054.
- Traoré, K. & Toé A. M. (2008). Capitalisation des initiatives sur les bonnes pratiques agricoles au Burkina Faso. Rapport de consultation, MAHRH/DVRD, Ouagadougou, Burkina Faso, 99 p.
- Whitford, F.; Martin, A. G.; Becovitz, J. D. (2006). Pesticides and Containers Management. Purdue Pesticide Programs/Purdue University Cooperative Extension Service Ed Purdue Pesticide Programs. PPP-21, 12p.
- WHO & FAO (2008). International Code of Conduct on the Distribution and Use of Pesticides/Guidelines on Management Options for Empty Pesticide Containers. WHO/FAO, 47p.

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Pesticides in the Modern World - Trends in Pesticides Analysis

Edited by Dr. Margarita Stoytcheva

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The book offers a professional look on the recent achievements and emerging trends in pesticides analysis, including pesticides identification and characterization. The 20 chapters are organized in three sections. The first book section addresses issues associated with pesticides classification, pesticides properties and environmental risks, and pesticides safe management, and provides a general overview on the advanced chromatographic and sensors- and biosensors-based methods for pesticides determination. The second book section is specially devoted to the chromatographic pesticides quantification, including sample preparation. The basic principles of the modern extraction techniques, such as: accelerated solvent extraction, supercritical fluid extraction, microwave assisted extraction, solid phase extraction, solid phase microextraction, matrix solid phase dispersion extraction, cloud point extraction, and QuEChERS are comprehensively described and critically evaluated. The third book section describes some alternative analytical approaches to the conventional methods of pesticides determination. These include voltammetric techniques making use of electrochemical sensors and biosensors, and solid-phase spectrometry combined with flow-injection analysis applying flow-based optosensors.

How to reference

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InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

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