Producers' perceptions on the risks related to the use of Endosulfan in Benin and Togo

IPEN Working Group Project

REPUBLIC OF BENIN

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AIC	: Agence Interprofessionnelle de Coton
ANCE	: Association Nationale des Consommateurs et l'Environnement
ATC	: Agent Technico-Commercial
ATSDR	: Agency for Toxic Substances and Disease Registry
CALLI-TOGO	: Calliope au Togo
CIEL	: Center for International Environmental Law
DA	: Direction de l'Agriculture
EPA	: Environmental Protection Agency
FAOSTAT	: Food and Agriculture Organization of the United Nations
FENAGROP	: Fédération Nationale des Groupements et Organisations des Producteurs
FUPRO	: Fédération des Unions des Producteurs
GAPROFFA	: Groupe d'Action pour la Promotion et la Protection de la Flore et la Faune
ICAT	: Institut de Conseil et d'Appui Technique
IITA-BENIN	: International Institute of Tropical Agriculture of Benin
INC	: Comité International de Négociation
IPEN	: International POPs Elimination Network
MAEP	: Ministère de l'Agriculture, de l'Elevage et de la Pêche
MEFP	: Ministère de l'Economie, des Finances et des Privatisations
MSP	: Ministère de la Santé Publique
OBEPAB	: Organisation Béninoise pour la Promotion de l'Agriculture Biologique
OMS	: Organisation Mondiale de la Santé
ONG	: Organisation Non Gouvernementale
OSPAR	: Convention pour la Protection du milieu marin de l'Atlantique du Nord-Est
PACOGE	: Réseaux de distribution des intrants agricoles
PAN	: Pesticide Action Network
PIB	: Produit Intérieur Brut
POPs	: Pollutants Organiques Persistants
PPWG	: POPs Pesticide Working Group
SAMAC	: Société Africaine des Matériels Agricoles et de Commerce
SDI	: Société de Distribution des Intrants
SEPO	: Succès Echecs Potentialités Obstacles
SG	: Secrétariat Général
SOCIAL LAB	: Laboratoire de Renforcement des Capacités en Sciences Sociales et Economiques
SOTOCO	: Société Togolaise de Coton
SPSS	: Statistical Package of Social Sciences
UPC	: Union des Producteurs de Coton

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About the International POPs Elimination Network (IPEN)

The International POPs Elimination Network (IPEN) is a global network of more than 600 members of non-governmental public interest organizations working in partnership for the elimination of persistent organic pollutants on an expedited yet socially equitable basis.

IPEN was officially created in 1998 during the first session of the Intergovernmental Negotiating Committee (INC1) of the Stockholm Convention on Persistent Organic Pollutants (POPs) in Montreal, Canada. The IPEN defined fundamentals to be integrated into a global POPs agreement, and the Stockholm Convention was adopted in 2001 and entered into force in 2004.

The IPEN and participating organizations confirmed their common commitment to continue to work together to implement the Convention on POPs by signing IPEN's Stockholm Declaration in 2001.

The IPEN has ensured the participation of non-governmental organizations across the five continents through their adherence to the platform. The IPEN is evolving and continues to support the participation of hundreds of NGOs to conferences on POPs and other chemicals of equivalent concern. The IPEN is comprised of a Steering Committee, Executive Committee, a Secretariat and two Co-Chairs.

The IPEN has created regional focal points in Africa, Latin America, Asia-Pacific, South Asia, Eastern Europe, the Caucasus, Central Asia and the Middle East. The regional focal points coordinate and communicate with member organizations of IPEN within the relevant geographical regions.

The IPEN has launched the following 3 working groups with specific activities related to the implementation of the treaty on the POPs:

- The Community Monitoring Working Group
- The Dioxin, PCBs and Wastes Working Group
- The POPs Pesticides Working Group (PPWG)

This project is part of the action plan of the PPWG for the year 2008.

Abstract

Endosulfan is an active ingredient for many synthetic pesticides. It is a multi-purpose insecticide widely used on cotton and vegetables, and also on orchards and forests. Endosulfan is not selective in controlling insects. Non-target organisms are also at high risk. It is also very harmful for health and the environment. Intoxication related to the use of endosulfan has been increasing over the years, especially in developing countries. It controls crop insects to improve yields quantitatively and qualitatively. In cotton growing areas, endosulfan is among the most widely used pesticide. Its utilization has negative effects on the health of producers and their families and the environment, and entails high financial costs. Producers' perceptions on the health and environmental effects related to the use of endosulfan may guide in working out alternative solutions, but have not been assessed in Benin and Togo. These farmers' perceptions with regard to the use of endosulfan in Benin and Togo were assessed during a socio-economic survey carried out in both countries with a sample of 50 producers in Benin and 80 in Togo; a total of 130 producers.

The results showed that almost all the producers use endosulfan in cotton pest control. All producers had adverse effects related to the use of endosulfan. Affections such as skin burns and irritations, nausea, and gastrointestinal upset are the most frequent related to the application of endosulfan. Long-term disorders such as impotency and blurred vision are also recorded. More than half of the producers know about the harmful impact of endosulfan on soil fertility and the decrease in the population of insects in both countries.

In Benin and Togo, the distribution structures of synthetic pesticides including endosulfan are certified by importing companies working in collaboration with producers' organizations and structures in charge of managing the cotton sector. These are SDI, DFA and SAMAC in Benin, and CALLI-TOGO and SOTOCO in Togo. The study has shown that there is a legal framework that is more and more efficient for the management of chemical products in Benin and Togo. A strict resolution was taken by the Government of Benin to ban the use of endosulfan in the country.

1. General introduction

1.1 Background and justification of the study

The development of most Sub-Saharan African countries is based on agricultural production which is the principal source of wealth for the population. Agriculture employs 54% of the labour force and represents on average 70.2% of exports. It contributes up to 36% of the GDP of Benin (BDF, 2002). In Togo, agriculture remains the main supplier of employment (89 % of the population) and more than 93% of export earnings, about 37.8% of the GDP (PAN-TOGO, 2005).

Cotton is a very important cash crop in agriculture both in Benin and in Togo. The cotton sector is the most important source of wealth for the national economy and supplies monetary income for the population in Benin (Biaou, 2004). More than 52% of the rural populations draw their incomes from cotton production, which represents the main source of foreign currency (74% of the value of annual exploitations) (Peter et *Al*., 2004, Afrique agriculture, 2000). In Togo, it is the most important agricultural product of export in terms of exported volume (Djagni, 2007). The average production output of cotton lint is 50 000 tons per year with no real increase over the years. It is therefore clear that in the absence of a bountiful crop year, cotton production would not go beyond 100 000 tons of cotton lint with a relatively low increase of pesticides exportations in the sector.

Despite its importance, the cotton sector is facing tough challenges both at the technical and economic level. Attacks from a key pest, *Helicoverpa armigera*, cause significant yield losses ranging from 12 to 52% (Moussa et al, 2003). The available effective method to control the pest is the application of synthetic pesticides. The most effective and practical phytosanitary treatment is chemical control, with harmful effects on human health and environment; this results in a decrease in farmers' incomes due to the high prices of chemicals (Lawin, 2001). Except for officially banned POPs pesticides, the imports and the use of other pesticides have increased (PAN-Togo, 1995). In general, the biggest users of pesticides in Togo are the cotton sector (SOTOCO), the coffee and cocoa sector, the vegetables sector and, to some extent, the storage and conservation sector maize and cowpea. The trends of pesticide demands will therefore be a function of the progress of the activities in all these sectors.

Prior studies have revealed the use of cotton pesticides on vegetables; according to the words of vegetable growers in Togo who do so out of "ignorance" (ANCE). This is how endosulfan, a

very harmful pesticide presenting the same POPs characteristics, is currently being used in Benin and Togo.

In the Northern part of Benin, a hundred cases of intoxication due to endosulfan with 20 death cases were recorded in the main cotton production zones during the 2007-2008 crop year (MSP, 2008). Several studies have proven the harmful effect of endosulfan on the body and mucosa of eyes and respiratory tracts (PAN-Germany, 2007). Several acute intoxication symptoms appear in the human beings. These include: vomiting, diarrhoea, headaches, body aches and anxiety. In the case of lack of protein, the effects of endosulfan contamination are more severe and result in acute deficiencies in vitamins, hence malnutrition in developing countries. In Benin surveys revealed 347 cases of intoxication and 53 deaths (PAN UK, 2001, PAN Afrique, 2002 and OBEPAB, 2003).

The challenge is to reduce or to prohibit the use of chemical pesticides, mainly endosulfan. Better information and knowledge on the risks related to the use of endosulfan contribute to safeguarding health and the environment in Benin and Togo.

It is within this framework that the Group of Action for the Promotion and Protection of the Flora and Fauna (GAPROFFA), with support from the IPEN (International POPs Network Elimination), undertook this study to achieve the goals of the Stockholm Convention, to which Benin and Togo have adhered since 2001. The socio-economic surveys have further enabled us to identify health and environmental problems related to the use of endosulfan.

1.2 Literature Review

1.2.1 Endosulfan and its use

Endosulfan is a mixture of isomers of the chemical family of the organo-chlorine. The substance was developed in the middle of the 1950s (INERIS, 2006) and is presented in the form of brown crystals that are stable with light and insoluble in water. Its simplified formula is: $C_9H_6Cl_6O_3S$. Endosulfan is an insecticide/acaricide that acts by contact and ingestion. It is commonly used on main crops (cereals, crucifer, oil crops, field bean, potato), on fruit trees (apricot tree, black garden currant, raspberry, cob-nut tree, hickory, apple-tree), on vegetables (asparagus, garden beet, carrot, cucumber, pickle, summer squash, cabbage, garden-lettuce, melon) and ornamental crops (rose bush), etc.

It decomposes upon heavy heating, and produces toxic smoke including chlorine and sulfuric oxides. It reacts with the basis, causing risks of intoxication by sulphur dioxide fumes. Endosulfan may be absorbed through inhalation, skin contact and ingestion. It can affect the central nervous and blood system resulting in irritability, convulsions and renal failure (PISSC, the CEC, 1999). Exposure to high concentrations may result in death. The effects can lag. Long term effects include damage to the aquatic environment. Particular attention should be given to soil organisms and birds. Bioaccumulation may be produced throughout the food chain.

1.2.2 Situation of endosulfan in the world

The world production of endosulfan was estimated at 10,000 tons per annum in the 1980s (ATSDR, 2000). The use of endosulfan in the European Union (EU) has been decreasing during the past years. A survey carried out by the Fraunhofer Institute in 2002 showed that the European Union produces each year between 10,000 and 50,000 tons of endosulfan. European and German companies are the largest producers of endosulfan in the EU. For example, 100 to 200 tons of endosulfan are consumed in France per year, that is about 15 % of the quantities used by Europe at that time (OSPAR, 2005).

Endosulfan is no longer authorized as a pesticide in four (4) countries in the world. There is a total ban of the active ingredient in Sri Lanka, Norway, Belize and the Netherlands. Four other countries including the Federal Republic of Germany have severely restricted its use. The European Union considers old pesticides in the framework of their guidelines 91/414 concerning the marketing of plant protection products; endosulfan is still in a "control procedure", which is a restrictive measure under the 91/414 directive. Although endosulfan is banned or severely restricted in some countries, it is still being used in other parts of the world.

From 2000, it has once again been authorized for use in some West African countries like Senegal. In Senegal, cotton production had strongly decreased as a number of insects developed a certain resistance to the other synthetic pesticides that replaced endosulfan. The cotton production dropped from 50.576 tons in 1992 to 11.623 tons in 2001 with a huge use of endosulfan (29,331 litres) resulting in harmful effects on the population mainly in the rural communities and the environment.

1.2.3 Biopesticides

According to the U.S. Environmental Protection Agency (EPA, 2007), biopesticides are pesticides derived from animals, bacteria, fungi, plants and certain minerals. They are generally

classified into 3 categories including biochemical pesticides (pheromone traps and plant extracts), which are less toxic for humans in controlling pests; pesticides made out of microbes (bacteria, fungi, entomopathogenic virus or protozoa), which can control the various types of pests, and systems protectors such as *Bt*: Dipel and Biobit used in Ghana (Coulibaly et *Al,* 2006). The use of biopesticides for parasitic control has the particular advantage of decreasing health hazards to children and women and the risks of environmental pollution (Adétonah, 2005). For example, the neem (*Azadirachta indica* A. Juss) is a natural and non toxic product for human beings: it is 100% biodegradable, protects the environment better and has a broad spectrum action on more than two hundred (200) pests species. (EPA, 1993).

1.3 Legal framework

1.3.1 Legal framework in Benin

From colonial times to date, about five hundred national legal materials, and about thirty agreements, treaties and conventions ratified by Benin, have been registered and represent the national legal structure for environmental management. That means that Benin has a growing and persistent commitment for environmental protection. The statutory laws in force in the chemical sector in Benin are reported in Annex 1.

The government of the Republic of Benin, following a cabinet meeting communication on the damage caused by endosulfan on the health and the life of the user populations and on environmental degradation, banned the use of endosulfan to control cotton pests for the coming agricultural crop years. This dangerous product with harmful effects on human health and the environment will be replaced by alternatives such as THIAN 175-O.TEQ, which will be used as a supplement to the residual stock available estimated at 576.052 litres (Statement of cabinet meeting, February 2008).

1.3.2 Legal framework of the environment in Togo

Endosulfan is not subject to any restraining measures in Togo. Civil society is struggling hard for its prohibition. The formulations used in Togo are: Phaser, Caiman (organo-chlorine used as alternatives to pyrethrenoïds to control *Helicoverpa armigera)* and Thionex (ANCE, 2007). Statutory laws in force in the chemicals sector in Togo are attached in Annex 2.

2. Objectives

The overall objective of the study is to document the risks related to the use of endosulfan on human health and the environment in Benin and Togo.

Specific objectives are:

- To identify the socio-economic and demographic characteristics of producers, users and non-users of endosulfan.
- To assess producers' perceptions on the risks related to the use of endosulfan.
- To identify health and environmental problems related to the use of endosulfan.
- To document the legal framework and the different domains of activities linked to the use of endosulfan.
- To identify the endosulfan supply chain and the various stakeholders involved in the marketing of endosulfan in Benin and Togo.

3. Study area

3.1 Presentation of study areas

The study was conducted in the region of Oti in Togo and Kandi in Benin.

3.1.1 Oti region in Northern Togo

The Oti area is located in the south of the Savannah region and spreads to the extreme North-East of the region in North-Eastern Togo. It is made up of the Mango plain, the valley of Oti, the Gando plain and part of the upland of the Kéran. The landscape is marked by the plain of Oti crossed by the Oti River and its tributaries. The climate is a Sudanese type where the alternation of seasons is characterized by a rainy season from May to September and a dry season from October to April with a cold season. Annual average rainfall ranges from 1000 to 1300 mm with temperatures between 17°C and 39°C. The population include the Mobas, Gourmas, Tchokossi and the N'Gam-gam. The population density is low (20 inhabitants/km²) on average, with small groups of population mainly composed of farmers. The main crops include:

- Cereals: sorghum, maize, millet, rice
- Grain legumes: cowpea, groundnut, Bambara nut;
- Tubers: yam, cassava
- Vegetables: okra, rosella
- Cash crop: cotton

The Oti region is known to be one of the best cotton growing areas with an intensive use of endosulfan (ANCE, 2007). It is also an area of high production of vegetables. In this area farmers commonly intercrop cotton with food crops such as maize and vegetables: okra, red pepper, etc. Endosulfan is intensively used in agricultural production and in other productions such as fisheries, livestock, etc. The area includes farmers that use endosulfan and also those that do not. The figure below shows the diagrammatic location of the Oti inland valley.

Figure 1: Location of the Oti inland valley

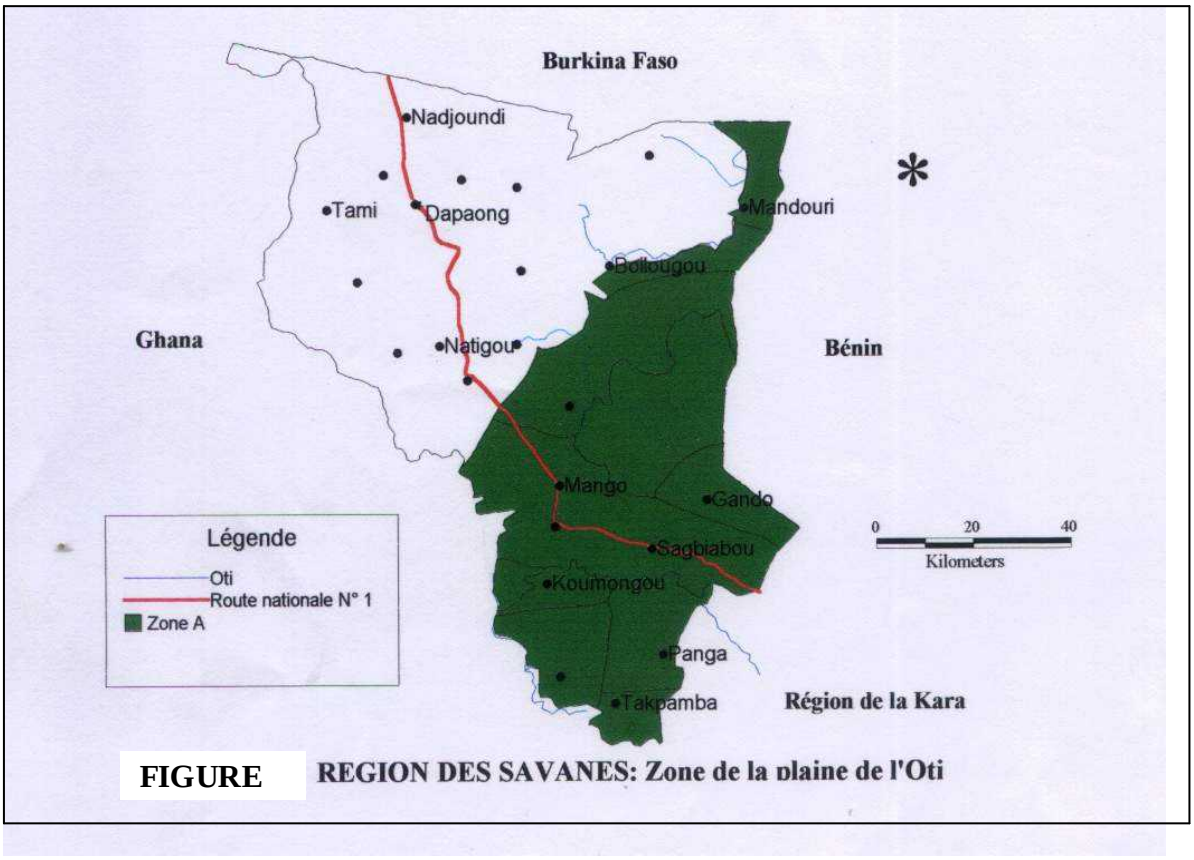


Figure 1: location of the OTI inland valley

3.1.2 Kandi region in Northern Benin

The commune of Kandi is located in the Department of Alibori in Benin. It covers an area of 3.421 km2 and is limited in the north by the commune of Malanville, the south by the commune of Gogounou, the west by the commune of Banikoara and the east by the commune of Sègbana.

The population of Kandi is mainly inhabited by the following ethnic groups: Bariba, Peuhl, Yoruba, Dendi, Fon, Otamari, Adja and Yom Lokpa. The total population is 90,640 inhabitants with a density of 21.40 inhabitants/km2. The number of households is 8624 with an average household size of 8.50 persons. Islam is the dominant religion followed by Catholicism and Animism. Economic activities in the commune are: agriculture, livestock, commerce, handicraft, transport and processing of products. The main crops are maize, cotton, groundnut and millet.

The commune of Kandi is one of the biggest areas to produce biological and conventional cotton. It is located in the northern part of the country which is a major cotton production area. Cotton is a crop that demands a lot of chemicals, including endosulfan. Several cases of intoxication due to chemical poisoning have been reported in the region. In this region, there are also users and non-users of endosulfan.

Figure 2: Location of Kandi in Benin

Figure 2: Location of KANDI in Benin

4. Methodology

4.1 Criteria for site selection

The choice of the villages was based on agro-ecological and socio-economic criteria such as the importance of cotton in the cropping system, the number of producers using endosulfan, the prevalence of risks related to endosulfan, the presence of producers not using endosulfan in the area and the surroundings of the village.

4.2 Sampling of producers

The sample was made of three categories of stakeholders: farmers using endosulfan, non users of endosulfan, and other stakeholders involved in the risk management of chemicals (extension and health agents, input sellers, consumers of farm products and fishermen).

Producers not using endosulfan were adequately selected given their very low number, and those who were users of endosulfan were randomly selected. In total, 130 farmers were selected in Benin and Togo at a rate of 50 farmers in Benin, 80 farmers in Togo and 30 among the other stakeholders.

4.3 Data collection

The primary data were collected through structured interviews by using semi-structured questionnaires administered to the producers: users and non-users of endosulfan and other stakeholders involved in the management of risk related to chemical pesticides.

The secondary data was collected from agricultural research and development institutions in Benin and Togo. The focus group method was used to collect data related to farmers' perceptions, health agents, consumers, rural instructors, fishermen and input sellers on the strengths and weaknesses related to the use of endosulfan.

4.4 Data Analysis

The data was processed and analyzed with Excel and the Statistical Package of Social Sciences (SPSS, version 16.0) software. Descriptive statistics were used to obtain the averages, frequencies, and standard deviations and to do cross-tabulations. SEPO, a tool for evaluation, was used to assess successes, failures, potentials and constraints related to the use of endosulfan by the producers and their instructors.

5. Results and discussion

5.1 Socio-economic and demographic characteristics of surveyed producers in Benin and Togo

The socio-economic and demographic characteristics are presented in Table 1. The majority of the surveyed producers are men (80%). Farming is the main activity, with an average experience of 21 years (±11.52) in both countries. The experience of the producers in cotton farming is 14 years on average and men and women are cotton producers, but the percentage of women in this activity is very low in Benin and Togo. These observations confirm the results of Adetonah *et al.* (2007), that showed that the majority of cotton farms (90%) are lead by men in Northern Benin.

The marital situation analysis revealed that the majority of the surveyed people (94%) are married with a very low proportion of singles, widowers and divorcees (respectively 3%, 1% and 2%).

The surveyed producers belong to all age groupings. The average age is 42 (±13.383), and ages range from between 18 to 85 years old in both countries.

The education level is relatively low in both countries. However, it is an important factor in understanding the risk factors related to the use of endosulfan. Almost all producers (90%) are illiterates in Togo against 58% in Benin. The proportion of producers who have reached the primary school level is higher in Benin.

Informal education is negligible. Very few producers participated in the farmer's field school.

Table 1: Socio-economic characteristics of surveyed producers

Characteristics	Country		Total (%) N= 130
	Benin (%) N=50	Togo (%) N=80	
User of endosulfan	60	61	61
Non user of endosulfan	40	39	40
Man	82	79	80
Woman	18	22	20
Average ages	41	42	42
50 years and above	20	18	19
Level of education			
With no schooling	58	90	78
Primary school	26	7	14
Farmers' school	4	0	2

Others	12	4	7
Marital situation			
Single	4	3	3
Married	96	94	95
Divorcee	0	3	2
Widower	0	2	1

Source: Results of 2008 survey

In Benin, 40% of the producers are users of biopesticides and 60% are users of endosulfan. Among producers interviewed in Togo, 39% use biopesticides and 61% use endosulfan. Among the users of biopesticides, women represent 18 % in Benin and 13 % in Togo. Only a few women use endosulfan in Benin (1 %) against 9 % in Togo. On the contrary, a greater number of women use biopesticides in both countries. Women use much more alternative control methods, especially botanic extract of neem, compared to men who can afford synthetic chemical pesticides (Adetonah et *al., 2006).* Cheap methods to control insects and diseases are generally used by women who lack revenues to afford expensive inputs (Coulibaly *et al.*, 2006). Collection of neem leaves and extracts are often considered to be activities that are more appropriate for women.

5.2 Producers' perceptions on the risks related to the use of endosulfan

Producers have a great knowledge on the health and environmental risks related to the use of endosulfan. This knowledge varies from one zone to another.

5.2.1 Producers' Knowledge on the use of endosulfan

The analysis of Table 2 shows that almost all producers (95 % and 99 % in Benin and Togo respectively) know about the existence of adverse effects related to the use of endosulfan and therefore would like to use biopesticides (86% and 73%) that do not have adverse effects on health and the environment. They are aware of the drawbacks related to the use of endosulfan and the benefits of biopesticides. Producers in Benin are aware of the dangers related to handling endosulfan (OBEPAB ,2006).

Table 2: Cotton producers knowledge on the benefits and drawbacks of endosulfan and biopesticides in Benin and Togo

Country	Control products	Benefits	Drawbacks	Total N= 130
Benin	Biopesticide	20	1	21

	Endosulfan	4	25	29
Togo	Biopesticide	31	0	31
	Endosulfan	13	36	49

Source: 2008 survey

In agriculture, cotton is the crop in which endosulfan is the most frequently used. In Benin, it is the only crop really organized into a sector where input supply is assured. However, it is important to note that pesticides are used on other food crops such as cowpea and other vegetables such as pepper, okra and tomato.

5.2.2 Knowledge on the health impacts

Producers have different knowledge about the impact of the use of endosulfan on health as well as on the environment. They have a more or less good knowledge on the consequences related to handling endosulfan. Various health disorders are recorded after treatments with endosulfan in Benin and in Togo (Table 3).

Table 3: Diseases dues to the use of endosulfan (%)

Diseases (%)	Burn	Itching	Cough	Blurred vision	Diarrhoea	Sexually impotent	Dermatosis	Nausea	Vomiting	Stomach ache
Benin	30	20	10	5	5	5	10	15	0	0
Togo	19	0	0	0	0	0	0	30	20	8

Source: 2008 survey results

Skin diseases (burns and skin irritations), nausea and stomach disorders are the most frequent. Contrary to the absence of data on intoxication due to pesticides in Davié in Togo, the study revealed several cases of diseases related to the use of endosulfan in health centres in Togo and Benin. Nausea, often with vomiting, was signalled by 30% of producers in Togo against 15% in Benin. Long term disorders such as impotency and blurred vision are often observed among adult people.

Health care providers have stated that in addition to the clinical signs enumerated by producers, other signs such as agitation, faintness, respiratory problems, stomach aches, and memory disorders are frequent following intoxications. In Northern Benin, similar diseases like dermatosis, headaches, dizziness and eyes problems are reported in major cotton-producing community centres (Loumedjinon, 2002). The first intoxication risks are due to the lack of protection during spraying. Very few producers have complete sets of protective equipment (gloves, masks, muffler, eyeglasses, and proper protective clothing) for treatments. The difficulty to access protective equipment is due to the lack of financial means. This limits their utilization, even if producers are aware of the necessity to protect themselves. The results of surveys have shown that less than one third (23%) of the producers wear protective equipment in Benin, against 2% in Togo, during endosulfan treatments. Previous studies have shown that in the Ouémé inland valley and in the commune of Klouekanmey, 54% of the surveyed producers do not protect themselves, 9 % wear protective clothing (shirt and trousers), 22 % wear masks and gloves, and 10% wear clothes (Adigoun, 2002).

In addition to the expenses to buy protective equipments, climatic conditions of tropical regions make it difficult to wear protective clothing because of very high temperatures. Treatments are often

done in the afternoons, which are the hottest periods of the day. With this intense heat, farmers prefer avoiding wearing recommended protective clothing.

The second intoxication risk is food-intoxication during spraying. The majority of farmers who have vast acreages of cotton to crop, are forced to break and eat, drink or smoke (Loumedjinon, 2006).

Very often, households do not differentiate between treated seeds and cereals to make flour for domestic consumption. A food-intoxication case that happened during data collection in the village of Kassakou (Northern Benin) is the following:

An old producer mistook endosulfan put on the table for milk that was also in the sage packaging like endosulfan. Without paying attention, he poured the endosulfan that he took for milk in the porridge and drank it. He died before reaching the hospital.

The mechanism of action of endosulfan in the body has not yet been elucidated. Some research works show that this highly toxic substance acts directly on the central nervous system.

The level of education and information are important factors in the techniques to handle endosulfan. Users of endosulfan, mainly rural producers, who speak local languages, cannot understand instructions put on the products in European languages. This situation increases their vulnerability to intoxication. Information and sensitization towards this target group is essential.

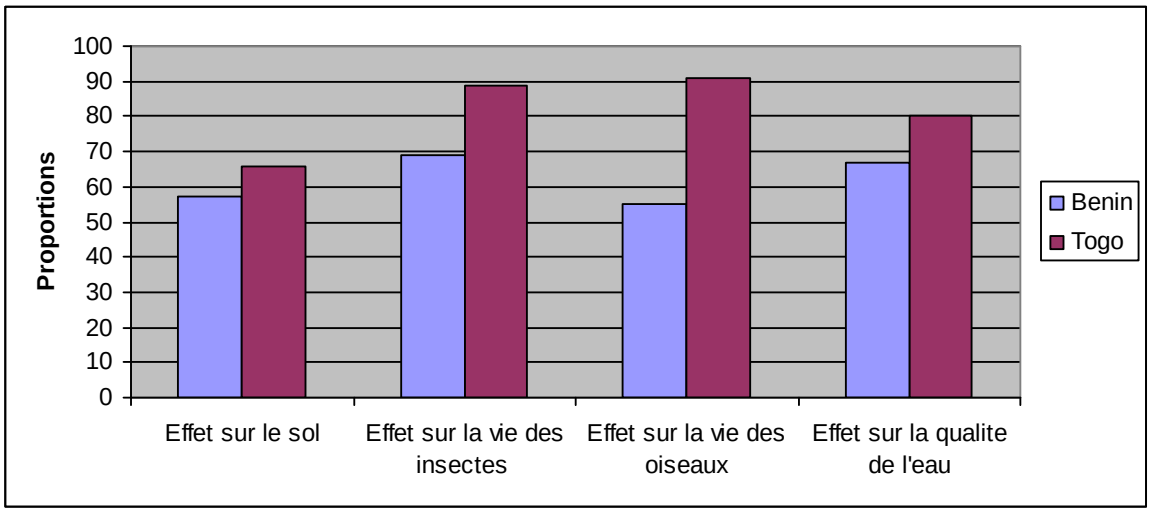
5.2.3 Producers' perceptions and knowledge on environmental impact

5.2.3.1 Endosulfan

Ensodulfan has tremendous environmental effects. It is very toxic for all organisms since very small doses are enough to cause long-term damage on animals and plants. Bioaccumulation of this substance may accumulate throughout the food chain.

Producers' perceptions on the environmental problems related to the use of endosulfan are presented in Figure 3:

Figure 3: Producers' perception on the environmental impact of endosulfan



Effect on the soil; effect on the life of insects; effect on the life of birds; effect on the quality of water

Source: 2008 survey

The majority of producers are aware of the environmental damages caused by endosulfan. More than half of the producers in Benin (57%) and in Togo (66%) think that the use of endosulfan has a negative impact on soil fertility. Endosulfan decreases soil fertility either through direct actions by destroying the useful soil micro-organisms; or through indirect actions by destroying the preys of a predator insect living in the soil or also by accumulation of substances that are toxic for plants (copper for example). Producers believe that endosulfan has an effect on the insect population and earth worms in Benin and Togo. The application of the product kills insects and ants, and decreases the population of micro-organisms. Soil microfauna is thus destroyed as well as small rodents. This aggravates soil infertility due to the lack of decomposers of organic elements necessary for the production of humus litter. 69% of the producers in Benin and 89% in Togo declare that endosulfan has a negative effect on insect population.

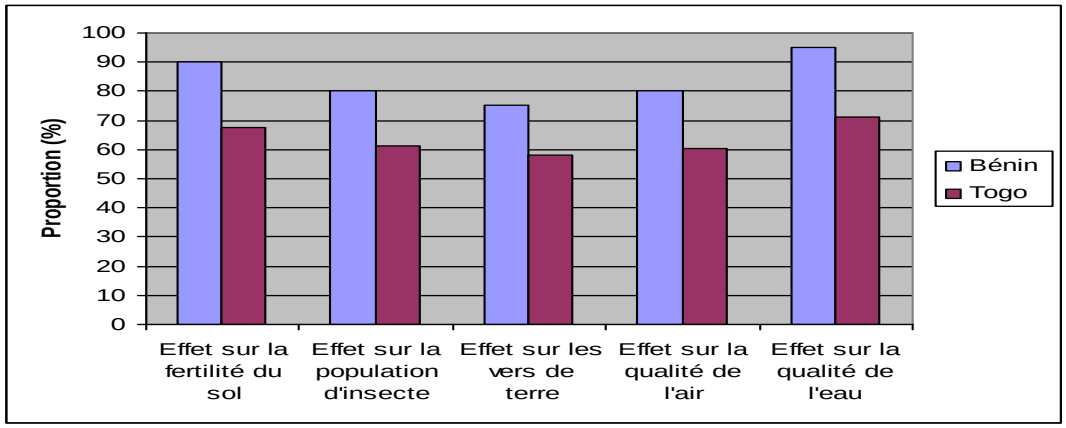
Water contamination is a major risk for the health of people and animals consuming this resource. Endosulfan pollutes waters in the wells, rivers and runoff waters. It is used in mass fishing and in the treatment of skin diseases of animals, especially heavy livestock. Respectively 67% and 80 % believe that the use of endosulfan has an effect on the quality of water in Benin and Togo. Contrary to organophosphorous and pyrethroid insecticides that are quickly degraded, organochlorines such as endosulfan are persistent. They accumulate in food chains and in the environment with all the consequences that may result.

In Benin and Togo, producers stipulate that it has effects on the bird population (respectively, 55 % and 91%). The life of birds is affected after each treatment with endosulfan. Birds eat dead insects that sicken them.

5.2.3.2 Biopesticides

Producers' perception on the environmental impact of biopesticides is represented in figure 4 below:

Figure 4: Producers' perception on the environmental impact of biopesticides



Effect on soil fertility; Effect on the insect population; Effect on the earth worms; Effect on the quality of air; Effect on the quality of water

Source: 2008 survey

The majority of producers use biopesticides because they do not have an environmental effect, particularly on soil fertility, air and water quality and on the insect population. In Benin, biopesticides are better known than in Togo. In Benin, the study has revealed the existence of producers in the zone who use biological production methods, therefore do not use chemical pesticides or endosulfan. Actions to reduce the use of pesticides include the introduction of biopesticides such as botanic extracts in the treatment of cowpea, and especially in market gardening. The adoption of biopesticides by the producers derives from information and awareness actions, and from the various technical support from extension agents that benefit Benin producers.

5.3 Areas of activities and stakeholders involved in the use of endosulfan

Farmers use a good number of chemical pesticides, including endosulfan, to control parasites in their crops. The proportion of producers (61%) who use it is entirely made of cotton producers.

In agricultural production, it is adults who handle endosulfan. It is generally done either by the farm head or by recruited temporary laborers. The sprayer is available but at a high cost (OBEPAB, 2006). After treatment of the cotton field, endosulfan is often left in the reach of children. Sometimes, children transport the equipment on their head in Benin and in Togo, thus increasing the risks.

5.4 Endosulfan supply

There are three endosulfan supply channels: formal structures, the producer to producer channel and the international market.

5.4.1 Formal distribution channels

Formal distribution channels of chemical pesticides in Benin and Togo are certified importing companies working in collaboration with producers and structures in charge of managing the cotton sector.

Generally, producers are supplied with endosulfan through the formal channel, contrary to other chemical pesticides, including POPs, which are distributed through the informal channel (OBEPAB, 2006).

Table 4: Major distribution channels of endosulfan in Benin and Togo

Channels	Benin	Togo
SDI	**X**	-
SOTOCO	-	**X**
PACOGE	**X**	-
DFA	**X**	-
CALI-TOGO	-	**X**
SAMAC	**X**	-

X: Presence

-: Absence

5.4.2 The informal channel (Producer to producer)

The input supply channel producer to producer plays a significant role in the commercialization and supply channel of chemical pesticides. The effect of neighbourhoods and kindred relationships, or

of belonging to knowledge exchange structures such as producers' groups, self-help groups, tontine, and any other more or less formal grouping contribute to information diffusion and to the good management of the distribution and commercialization channel of inputs.

5.4.3 The foreign market

Endosulfan is imported from European countries (France, Germany).

These European countries supply national markets. Sometimes, some producers living along borders stock up in neighbouring countries like Nigeria or Ghana.

This is how new pesticides are introduced in agricultural production. The problem is that there is no control about the quality or the risks related to the use of these products. Moreover, for lack of information and sensitization on the conditions for use, each producer applies his/her own doses and frequencies of treatment.

The global supply chain of the various stakeholders with endosulfan is illustrated by the following figure:

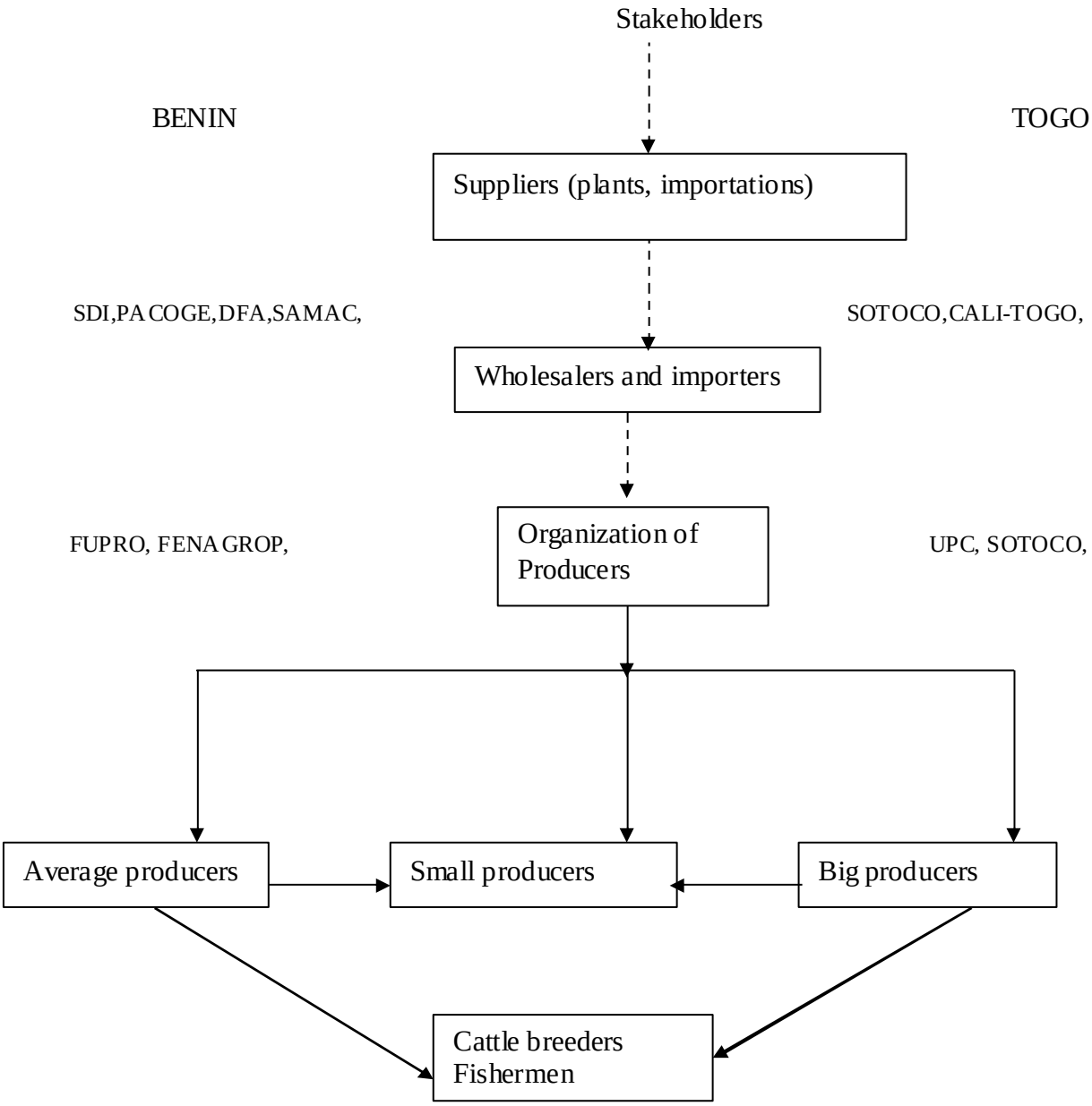


Figure 5: Commercialization channel of endosulfan in Benin and Togo

5.4.4 National stock of endosulfan in Benin and Togo

The consumption level of endosulfan in Benin and Togo over the last five (05) years is given in the following Table.

Table 5: National level of consumption of endosulfan in Benin and Togo

YEAR	BENIN			TOGO		
	Importation (litres)	Price to the producers (f.cfa)	Acreage treated (hectare)	Importation (litres)	Price to the producers (f.cfa)	Acreage treated (hectare)
2003	1.200.112[a]	6.000.560.000	375.000*	370.000	1.850.000.000	185.000*
2004	1.540.000	7.700.000.000	385.000*	400.000	2.000.000.000	200.000*
2005	764.864 [a]	4.283.238.400	310.000*	360.000	1.339.200.000	180.000*
2006	3.650.161 [a]	20.440.901.600	200.000*	210.000	781.200.000	105.000*
2007	1.398.803 [a]	5.735.092.300	350.000	123.000	346.860.000	61.500**
2008	982.052 [a]	4.026.413.200	250.000	186.000	524.520.000	93.000**

[a] Source CAGIA BENIN

* Source FAOSTAT 2008

The analysis of the table shows that endosulfan is consumed more in Benin. Despite the fact that it was banned in a Cabinet meeting, the certified importing company (SDI) has increased its stock by 406,000 litres in addition to the residual stock, to compensate for the shortage of THIAN 175-O.TEQ, the new product proposed by the Benin Government for the 2008-2009 campaign. This raises the current stock of endosulfan to 982,052 litres in Benin.

The cotton sector is well organized. It involves more producers of vast acreages of cotton in Benin than in Togo. The exorbitant purchase price of endosulfan during a campaign leads to a decrease of the purchasing power and a degradation of health and the environment. For example, the average purchase price of one litre of endosulfan is at least two times higher (4,900 FCFA in Benin and 3,850 FCFA in Togo) than the normal prices. This price is influenced by the evolution of the dollar rate and by national policies subsidizing agricultural inputs.

5.5 Evaluation of the strengths and weaknesses related to the use of endosulfan

The following figures show the results of SEPO carried out in Benin and Togo.

Figure 6: SEPO in Togo

Evaluation of the use of Endosulfan by producers and agricultural officers in Mango (OTI) in TOGO.

SUCCESS

- Reduction of the populations of helicoverpa and other caterpillars on the cotton plants.
- Reduction of the populations of insect pests on other crops.
- Efficiency of the product.
- Credit sale.

POTENTIALITIES

- Sensitization of producers on the consequences related to the use of the product.
- Training on good conditions to use the product (precautions to be taken).
- Protection of the skin during treatments.

DRAWBACKS

- Losses of human and animal lives (wild and domestic animals).
- Decrease in birds, useful insects and reptile populations.
- Contamination of water and the environment.
- Utilization of the product in market gardening.
- Non-respect of the utilization conditions.
- Diseases (vomiting, dizziness, ache, stomach ache, etc.)

OBSTACLES

- Refusal to sell on credit.
- Disappearance of SOTOCO.
- Non-efficiency of the product.
- Sale and import prohibition.
- High cost.
- Non-distribution.
- Sale of alternative products or efficient substitutes for food crops, too.
- Non-production of cotton in general.

Conclusion

Producers would like to have an efficient alternative product, less expensive and less risky for health and the environment. Strengthening of cotton producers' and other users' awareness and training is desirable and warranted.

Figure 7: SEPO in Benin

Evaluation of the use of Endosulfan by producers and agricultural officers in KANDI in Benin.

SUCCESS

- ü Decrease in the population of rodents
- ü Improvement of the cotton lint
- ü Yield increase
- ü Reduction of the treatment cost

POTENTIALITIES

- ü Body protection before the treatment
- ü Burning endosulfan packaging
- ü Reduction of toxic elements of the product since its production
- ü Strengthening producers' training and awareness on the health and environmental risks of the product
- ü Avoid direct contact with the product
- ü Distribution of the protective clothing with the products
- ü Increase in the selling price of the cotton
- ü Decrease in the purchase price of endosulfan

DRAWBACKS

- ü Higher health risks
- ü Contributes to poverty
- ü Affect men's virility
- ü Affects soil fertility
- ü Causes the death of people and animals
- ü Affects water and air quality

OBSTACLES

- ü Reduction in precaution (soap, gloves in the cardboards boxes of the products)
- ü Weakness at the level of training
- ü High cost of the product

Conclusion

Endosulfan is a chemical pesticide that improves significantly the yield of agricultural production. However, this quite expensive product causes serious health and environmental risks.

6. Conclusion

This study, in conformity with the objectives, afforded a better grasp of the different stakeholders involved in handling endosulfan and the resulting consequences for the environment and human health. Producers' perceptions on the risks related to the use of endosulfan have been covered in both countries. Producers' perception revealed that endosulfan causes diseases, the most frequent of which are skin diseases, nausea and stomach disorders. Environmentally speaking, it has effects on soil fertility, the population of insects and worms, and the quality of air and water. The proportion of women using biopesticides is generally higher than the one using endosulfan in both countries. Almost all producers recognize that the use of biopesticides is harmless while the use of endosulfan is harmful for health and the environment.

This study is a data base and an efficient source of information on endosulfan in Togo and Northern Benin. Agriculture is the only sector where endosulfan is used in Bénin and Togo. Victims are always recorded during each cotton campaign in Benin despite sensitization. It is urgent to promote alternative protective methods such as biopesticides that are environmentally harmless.

Benin and Togo have a persistent and growing legal frame for the management of chemical products. The Benin government took a strict resolution to ban the use of endosulfan.

The study revealed three supply channels that are the formal channel, the informal channel and the foreign market. The national stock of endosulfan planned for the 2008-2009 campaign in Benin is five times more than the one in Togo.

To remedy this situation, the study recommends:

- Awareness campaigns on risky behaviours and the dangers related to endosulfan;
- Training of producers on simple techniques that are cheap and better protect human health and the environment;
- Information and encouragement of producers to use alternatives control methods like biopesticides;
- Initiation of IEC programs to sensitize local populations about the dangers of pesticides, especially endosulfan, by promoting biopesticides; and
- Advocacy with political authorities for a good application of the decision banning the use of endosulfan in Benin and the adoption of restrictive measures in Togo.

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