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Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
Chemical Review Committee
Second meeting
Geneva, 13–17 February 2006
Item 5 (b) of the provisional agenda*

Inclusion of chemicals in Annex III of the Rotterdam Convention: review of notifications of final regulatory actions to ban or severely restrict a chemical: methyl parathion

Methyl parathion: supporting documentation provided by Côte d'Ivoire

Note by the secretariat

The annex to the present note contains the supporting documentation provided by Côte d'Ivoire in support of its final regulatory action on methyl parathion. When the notification by Côte d'Ivoire on methyl parathion was considered by the Chemical Review Committee at its first meeting, the supporting documentation was not available for consideration.

* UNEP/FAO/RC/CRC.2/1.

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Annex

List of supporting documentation on methyl parathion from Côte d'Ivoire

- Catalogue phytosanitaire de Cote d'Ivoire 2003
- Analyse socio-économique de la filière des pesticides en Côte d' Ivoire
- Profil national pour évaluer les capacités nationales de gestion des produits chimiques
- Problématique pour la conservation post-récolte des céréales stockées, recherche de résidus et études des effets secondaires
- Décret N 89-02 du 04 Janvier 1989
- Etude de la qualité de l'eau des étangs piscicoles de Korhogo

NOTE :

Annexed to this document is the English translation of the submitted documentation

Côte d'Ivoire
Ministry of Agriculture and Livestock
Directorate General of Agriculture
Directorate of Plant Protection and Quality

PHYTOSANITARY INDEX 2000

SENCHIM
CHEM-IVOIRE

Decree 89-02 of 4 January 1989

regarding the certification, manufacture, sale and use of pesticides

Republic of Côte d'Ivoire
Union – Discipline – Labour

Ministry of Agriculture

Ministry of Livestock Production	**Ministry of Forests and Water**	**Ministry of Public Health and Population**
Ministry of Scientific Research	**Ministry of Industry and the Plan**	**Ministry of Finance**
Ministry of Trade	**Ministry of Public Works and Transport**	**Ministry of Defence**
	Ministry of Internal Security	

Decree 89-02 of 4 January 1989 regarding the certification, manufacture, sale and use of pesticides

THE PRESIDENT OF THE REPUBLIC

FOLLOWING the report of the Ministers of Agriculture, Livestock Production, Forests and Water, Public Health and Population, Scientific Research, Industry and the Plan, Finance, Trade, Public Works and Transport, Defence, and Internal Security,

TAKING ACCOUNT OF Law 63-301 of 26 June 1963 regarding the suppression of fraud in the sale of goods and adulteration of foodstuffs and agricultural produce,

TAKING ACCOUNT OF Law 64-490 of 21 December 1964 regarding plant protection,

TAKING ACCOUNT OF Decree 63-457 of 7 November 1963 establishing the conditions for the import and export of plant and other materials capable of carrying organisms dangerous to crops,

TAKING ACCOUNT OF Decree 74-388 of 7 August 1974 regarding the certification of pesticides,

HAVING CONSULTED the Council of Ministers,

DECREES

CHAPTER I: CERTIFICATION OF PESTICIDES

ARTICLE 1

Any pesticide must have received certification or provisional sales authorization prior to its importation or its manufacture in Côte d'Ivoire.

ARTICLE 2

The following shall be considered pesticides:

- any substance or combination of substances intended either to repel, destroy or control pests, vectors of human or livestock diseases and undesirable species of plant or animal that cause damage or are otherwise harmful during the production, processing, storage, transport or marketing of foodstuffs, agricultural produce, timber, wood products or livestock feedstuffs, or to be applied on livestock to control insects, arachnids and other ectoparasites;
- regulators of plant growth, defoliants, desiccative agents, fruit thinning agents, agents intended to prevent fruit from falling prematurely, and substances applied to crops before or after harvesting to protect produce against deterioration during storage or transport.

ARTICLE 3

Certification shall be granted through an order of the Minister of Agriculture on the recommendation of a Pesticide Committee made up of:

- one representative of the Minister of Agriculture (Chairman);
- one representative of the Minister of Livestock Production;
- one representative of the Minister of Forests and Water;
- one representative of the Minister of Public Health and Population;
- one representative of the Minister of Scientific Research;
- one representative of the Minister of Industry and the Plan;
- one representative of the Minister of Finance;
- one representative of the Minister of Trade;
- one representative of the Minister of Public Works and Transport;
- one representative of the Minister of Defence;
- one representative of the Minister of Internal Security.

Each minister shall nominate his or her representative and a substitute for the latter.

The committee shall be constituted by an order of the Minister of Agriculture and meet on the convocation of its chairman.

The permanent and session secretariat shall be provided by the Ministry of Agriculture.

ARTICLE 4

Any application for certification of a pesticide shall be addressed to the Minister of Agriculture, written in French and using the metric system, and must allow an appreciation of the toxicity and efficacy of the product.

Such application shall include in particular:

1. a request for certification with precise mention of the business name and address(es) of the manufacturer and/or distributor of the brand;

2. the trade name proposed for the pesticide; this name must be different from the common standardized names of active substances and must not be capable of causing confusion as to uses;
3. the exact composition of the product in terms of quality and quantity (including additives), submitted under separate, confidential cover, together with samples;
4. the common name, if this exists, the chemical identity and the specific physical and chemical properties of the active substance, together with storage conditions required for stability;
5. adequate toxicological reports on the active substance(s) and the prepared product (toxicological category, DL 50, risks and symptoms of poisoning, antidote, and, if possible, advice for medical staff);
6. the general features of the product (insecticide, fungicide, acaricide, etc.), its uses, crops to be treated, and conditions of use;
7. the form in which the product is presented;
8. the nature, capacity and closing system of the anticipated packaging, with any splitting of the authorized packaging and any bulk sale being forbidden;
9. the method of use, precautions to be taken by users, and counter-indications;
10. time lapses required prior to harvesting, grazing, slaughtering or consumption of produce;
11. any incompatibility with other pesticides;
12. the proposed label to be attached to packaging; this shall give full instructions for use, together with the manufacture and expiry dates and storage conditions;
13. the method(s) used for analysis of the prepared product;
14. the determination method(s) used for residues of the product;
15. reports on any experiments in this connection carried out by national or foreign research institutes;
16. copies of any decisions taken in other countries regarding certification or sales authorization or restriction.

This list is not exhaustive, and any other information may be requested by the committee, which is in any case the sole judge of the acceptability of the documentation submitted.

ARTICLE 5

When the committee sees fit, it may consult any expert in the field, or request the assistance of official research bodies, qualified services of the ministries making up the committee and foreign laboratories, in order to carry out any experimentation and checking needed for an appreciation of the applications received, and, in due course, for the monitoring of approved products.

The beneficiary of the certification shall bear the cost of such experimentation or checking.

ARTICLE 6

After examination of the application for certification, the Pesticide Committee shall propose one of the four following lines of action to the Minister of Agriculture:

- granting of certification for a five-year period, with renewal to be requested at least six months prior to expiry;
- granting of provisional sales authorization for a two-year period, at the end of which a definite decision must be taken;
- further study, without the granting of any provisional sales authorization;
- refusal of certification (entailing the obligatory withdrawal of any provisional sales authorization previously granted).

These measures, taken in the form of orders, may be expressed separately for a single product, depending on the uses for which it is intended.

Certification and provisional sales authorization place the obligation on their recipient of strict compliance with the initial recommendations submitted to the Pesticide Committee and with any modifications by the latter concerning points 1, 2, 3, 4, 7, 8 and 12 of Article 4 above. If a product contains poisonous substances, no provisional sales authorization may be granted, and in the case of certification the order shall mention the toxicological classification.

Any modification or extension to new uses is subject to prior authorization.

For certain pesticides with limited application and dangerous use, the certification or provisional sales authorization may be accompanied by a limitation on users.

Orders of certification or provisional sales authorizations may be modified, suspended or withdrawn at any time the committee sees fit.

Reasons must be provided for any decision regarding modification, suspension or withdrawal.

ARTICLE 7

The Pesticide Committee must be notified of any abandonment of an application for certification or any abandonment of some or all the uses of a certified product. Should the need arise, the committee shall then propose necessary modification(s) to the certification order.

ARTICLE 8

Any advertisement for pesticides that have received neither certification nor provisional sales authorization is forbidden, while no advertising for certified pesticides or those with provisional sales authorization may mention uses not indicated in the official texts.

ARTICLE 9

Only the research institutes of the Ministry of Scientific Research and laboratories and research stations of phytosanitary companies may carry out experiments using pesticides that have not yet received certification or provisional sales authorization.

Such experiments must be declared in advance to the Pesticide Committee, which may in due course order the destruction of crops grown on experimental plots.

Prior authorization from the Ministry of Agriculture based on the recommendation of the Pesticide Committee is required for the importation for experimental purposes of pesticides that have not received certification or provisional sales authorization.

CHAPTER II: ESTABLISHMENT OF PESTICIDE FACTORIES

ARTICLE 10

The establishment of any plant for the manufacture and/or packaging of pesticides requires specific prior authorization from the Minister of Industry and the Plan, based on the positive opinion of the Minister of Agriculture, formed after consultation with the Pesticide Committee.

CHAPTER III: CERTIFICATION OF PESTICIDE RETAILERS

ARTICLE 11

A pesticide retailer is defined as any individual or legal entity who obtains pesticides for marketing purposes from phytosanitary companies established in Côte d'Ivoire and legally recognized by the administrative authorities or companies that import such pesticides. The retailer shall be responsible for checking that purchased products have received certification or provisional sales authorization.

ARTICLE 12

Exercise of the profession of pesticide retailer requires prior certification.

Such certification shall be granted through a joint order of the Minister of Trade and the Minister of Agriculture, on the recommendation of the Pesticide Committee.

In order to obtain such certification, the applicant shall:

1. provide proof of general and practical knowledge regarding the properties and use of pesticides, either through a course with a phytosanitary company or through professional training or experience;
2. undertake to observe any limitations regarding the quantity or quality of imports;
3. have locked premises allowing the conservation of pesticides for normal use periods; such premises shall be separated from parts of the building occupied by human beings or livestock, be dedicated exclusively to the storage of pesticides and agricultural equipment, and have a danger sign affixed outside;
4. have safety equipment to detect any toxic gas leaks;
5. undertake to observe the phytosanitary regulations in force, and in particular to sell only certified pesticides in their original, hermetically sealed packaging;
6. undertake to have the distribution of pesticides as principal activity, and to attend any refresher courses organized by the ministries and companies concerned;
7. undertake to ensure that staff have periodic medical examinations.

ARTICLE 13

Any intermediary between the consumer and retailer acts under the responsibility of the latter, who shall inform the Pesticide Committee of the arrangement and guarantee that the dispositions laid down in Article 12 above shall be observed.

CHAPTER IV: CERTIFICATION OF PESTICIDE APPLICATORS

ARTICLE 14

A pesticide applicator is defined as any individual or legal entity who carries out the following actions for a third party:

- phytosanitary protection of crops;
- treatment of stored foodstuffs;
- chemical weed control;
- treatment of premises and equipment used to store agricultural produce;
- treatment of equipment and vehicles used to transport or store agricultural produce;

- treatment of public places, living quarters and premises housing livestock;
- external antiparasitic treatment of livestock.

ARTICLE 15

Exercise of the profession of applicator requires prior certification.

Such certification shall be granted through an order of the Minister of Agriculture, on the recommendation of the Pesticide Committee.

In order to obtain such certification, the applicant shall:

1. provide proof of general and practical knowledge regarding the properties and use of pesticides, either through a course with a phytosanitary company or through professional training or experience;
2. possess application apparatus suited to the various pesticide preparations;
3. possess appropriate and sufficient equipment to protect staff against exposure to pesticides during dilution, application and storage;
4. possess effective safety equipment to detect any toxic gas leaks;
5. possess a locked warehouse allowing the conservation of pesticides for normal use periods; such premises shall be separated from parts of the building occupied by human beings or livestock, be dedicated exclusively to the storage of pesticides and their application equipment, and have a danger sign affixed outside;
6. undertake to ensure that staff have periodic medical examinations;
7. undertaken to observe the phytosanitary regulations in force, and in particular to use only products that have been officially authorized for sale.

CHAPTER V: MISCELLANEOUS AND TEMPORARY DISPOSITIONS

ARTICLE 16

Pesticides intended for sale must be transported in conditions that eliminate any risk of contamination.

ARTICLE 17

After any pesticide application:

- empty packaging must be rendered unusable for any purpose;
- any remaining unused pesticide must be destroyed, taking all necessary precautions.

ARTICLE 18

Pesticide factories, retailers and applicators carrying out their activities on the publication date of the present decree shall have a period of three months to submit an application to the Pesticide Committee for regularization of their position. In the absence of any contrary decision, they may continue to exercise their profession until a ruling has been made on their case.

CHAPTER VI: PENALTIES

ARTICLE 19

Agents officially designated by the ministries listed in Article 3 are authorized to carry out any inspections in the premises and worksites of pesticide manufacturers, retailers and applicators. Any person who obstructs them in the exercise of their duties shall be liable to the penalties provided for in the regulations in force.

Any ascertained infringement shall lead to immediate seizure of the products in question, without prejudice to other administrative penalties and civil and penal prosecution provided for in the regulations in force.

With regard to pesticides, any infringement of Articles 6, 8 and 9, in particular the sale or distribution of products lacking certification or authorization, in bulk, expired, adulterated or with packaging or labels not in conformity with the authorized models, shall lead to immediate seizure of the stocks in question, without prejudice to other administrative penalties and civil and penal prosecution provided for in the regulations in force.

With regard to the exercise of the professions covered by the present decree, any ascertained infringement of Articles 11, 13, 14, 15, 16 and 17 shall lead to the closure of the establishment or the seizure of the vehicles concerned, without prejudice to other administrative penalties and civil and penal prosecution provided for in the regulations in force.

Any other infringement of the present decree shall be liable to the penalties provided for in the regulations in force.

CHAPTER VII: FINAL DISPOSITIONS

ARTICLE 20

Orders of the Minister of Agriculture, decided on jointly with the ministers concerned, shall establish the conditions for application of the dispositions of the present decree.

ARTICLE 21

The Ministers of Agriculture, Livestock Production, Forests and Water, Public Health and Population, Scientific Research, Industry and the Plan, Finance, Trade, Public Works and Transport, Defence, and Internal Security are each responsible as concerns execution of the present decree, which nullifies all previous dispositions on the subject, particularly Decree 74-388 of 7 August 1974, and shall be published in the Official Gazette of the Republic of Côte d'Ivoire.

Félix HOUPHOUET-BOIGNY
Abidjan, 4 January 1989

Active substance	Family	Page
2,4-D	Aryloxy-acetic derivative	
ACETAMIPRID		
ACETOCHLOR	Chloro-acetamide	
ACLONIFENE	Diphenyl-ether	
AFLETHIOLON CHRYSANTHEMATE		
ALACHLOR	Chloro-acetanilide	
ALDICARB	Carbamate	
ALLETHRIN	Synthetic pyrethrinoid	
ALPHACYPERMETHRIN	Synthetic pyrethrinoid	
ALUMINIUM PHOSPHIDE		
AMETRYN	Triazine	
ASULAM	Carbamate	
ATRAZINE	Triazine	
BENOMYL	Benzimidazole	
BENSULFURON METHYL	Sulfonylurate	
BENTAZONE	Benzothliazole	
BENTHIOCARB	Thiocarbamate	
BIFENTHRIN	Synthetic pyrethrinoid	
BIOPYBUTHRIN	Synthetic pyrethrinoid	
BITERTANOL	Triazole	
BMPC	Carbamate	
BROMACIL	Uracil	
BROMADIOLONE	Hydroxy-4-coumarin	
BROMOPHOS	Organophosphate	
BROMUCONAZOLE	Triazole	
CADUSAFOS	Organophosphate	
CARBARYL	Carbamate	
CARBOFURAN	Carbamate	
CARBOSULFAN	Carbamate	
CARTAP	Carbamate	
CHLOROPHACINONE	Indanedione derivative	
CHLOROTHALONIL	Phthalic derivative	
CHLORPYRIPHOS-ETHYL	Organophosphate	
CLOMAZONE	Isoxazolidine	
COPPER SULPHATE		
CYANAZINE	Triazine	
CYCLOSULFAMURON	Sulfonylurate	
CYFLUTHRIN	Synthetic pyrethrinoid	
CYPERMETHRIN	Synthetic pyrethrinoid	
CYPHENOTHRIN	Synthetic pyrethrinoid	
D-ALLETHRIN	Synthetic pyrethrinoid	
D-PHENOTHRIN	Synthetic pyrethrinoid	
DELTA-METHRIN	Synthetic pyrethrinoid	
DIALLETHRIN	Synthetic pyrethrinoid	
DIAZINON	Organophosphate	
DICHLORVOS	Organophosphate	
DIFENACOUM	Hydroxy-4-coumarin	
DIFENOCONAZOLE	Triazole	
DIMETHAMETRYN	Triazine	

DIMETHOATE	Organophosphate	
DINICONAZOLE	Triazole	
DIURON	Urea substitute	
D-PERMETHRIN	Synthetic pyrethrinoid	
ENDOSULFAN	Organochlorine	
ESBIOTHRIN	Synthetic pyrethrinoid	
ETHEPHON	Ethylene generator	
ETHOPROPHOS	Organophosphate	
ETOFENPROX	Synthetic pyrethrinoid	
FENITROTHION	Organophosphate	
FENOBUCARB	Carbamate	
FENVALERATE	Synthetic pyrethrinoid	
FIPRONIL	Phenylpyrazole	
FLOCOUMAFEN	Coumarin	
FLUAZIFOP-P-BUTYL	Aryloxyphenoxy-propionate	
FLUOMETURON	Urea substitute	
FLUROXYPIR	Pyridyloxyacetic acid derivative	
FLUSILAZOLE	Triazole	
FOLPEL		
FOSETYL-ALUMINIUM	Metallic monoethyl phosphite	
GLUFOSINATE-AMMONIUM	Aminophosphonate	
GLYPHOSATE	Aminophosphonate	
HALOXYFOP-R (methylic ester)	Aryloxyphenoxypropionate	
HYDRAMETHYLNON	Amidinohydrazone	
IMAZALIL	Imidazole	
IMAZAPYR	Imidazolinone	
IPRODIONE	Hydantoin	
ISAZOPHOS	Organophosphate	
ISOFENPHOS	Organophosphate	
ISOPROTHIOLANE		
ISOXATHION	Organophosphate	
LAMBDA-CYHALOTHRIN	Synthetic pyrethrinoid	
LINDANE	Organochlorine	
MALATHION	Organophosphate	
MANCOZEB	Dithiocarbamate	
MANEBE	Dithiocarbamate	
MEPIQUAT CHLORIDE	Piperidine derivative	
METALDEHYDE	Tetraoxacyclo-octane	
METCONAZOLE	Triazole	
METOLACHLOR	Chloro-acetanilide	
METRIBUZIN	1,2,4-triazinone	
MONOCROTOPHOS	Organophosphate	
MSMA	Organo-arsenic	
NAPHTHALENE		
NICOSULFURON	Sulfonylurate	
ORYZALIN	Toluidine	
OXADIARGYL	Aminophosphonate	
OXADIAZON	Oxadiazole	
OXAMYL	Carbamate	
PARAQUAT	Quaternary ammonium	
PARATHION-ETHYL	Organophosphate	

PENDIMETHALIN	Dinitroanaline	
PERMETHRIN	Synthetic pyrethrinoid	
PHENAMIPHOS	Organophosphate	
PHENOTHIOL		
PHENOTHRIN	Synthetic pyrethrinoid	
PHENTHOATE	Organophosphate	
PHORATE	Organophosphate	
PHOXIME	Organophosphate	
PICLORAM	Picolinic acid derivative	
PIPERONYL BUTOXIDE	Synthetic pyrethrinoid	
PIPEROPHOS	Organophosphate	
PIRIMIPHOS-METHYL	Organophosphate	
PLANT EXTRACTS		
PRETILACHLOR	Chloroacetanilide	
PROFENOFOS	Organophosphate	
PROMETRYN	Triazine	
PROPANIL	Amide	
PROPICONAZOLE	Triazole	
PROPOXUR	Carbamate	
SIMAZINE	Triazine	
SULPHUR		
SULFOSATE (or GLYPHOSATE-REMESIUM)	Aminophosphonate	
TEBUCONAZOLE	Triazole	
TEBUPIRIMPHOS	Organophosphate	
TEMEPHOS	Organophosphate	
TERBUFOS	Organophosphate	
TERBUTRYN	Triazine	
TERBUTYLAZINE	Triazine	
TETRAMETHRIN	Synthetic pyrethrinoid	
THIABENDAZOLE	Benzimidazole	
THIOBENCARB	Carbamate	
THIODICARB	Carbamate	
THIOPHANATE-METHYL	Carbamic acid derivative	
THIRAM	Dithiocarbamate	
TRALOMETHRIN	Synthetic pyrethrinoid	
TRIADIMEFON	Triazole	
TRIADIMENOL	Triazole	
TRIAZOPHOS	Organophosphate	
TRICHLOPYR	Pyridyloxyacetic acid derivative	
TRIDEMORPH	Morpholine	
ZETA-CYPERMETHRIN	Synthetic pyrethrinoid	

Ministry of Higher Education and Scientific Research

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Dissertation for the degree of Master of Science
Specialization: FOOD SCIENCES AND TECHNOLOGIES

Subject:

THE PROBLEM OF POST-HARVEST CONSERVATION OF STORED CEREALS, THE SEARCH FOR RESIDUES AND THE STUDY OF SECONDARY EFFECTS

Presented by:
KONE WALAMITIEN
Kinambin-Gisele

Scientific director:
Dr DEMBELE ARDJOUMA
Director of LABECO

Rodenticides

- Rat-col is recommended for warehouses, inasmuch as it is completely non-toxic for stored foodstuffs. CALLIVOIRE
- Callirat, a rat and mouse poison (0.0075% Chlorophacinone), is not recommended for foodstuff warehouses.

During our survey, we observed that some warehouse owners or managers use authorized products such as Percal or k-othrin for conservation, whereas others use unauthorized products such as Calthio (25% Thyran, 20% Lindane), an insecticide and fungicide used for the treatment of seed for horticultural crops, cereals, groundnut and cotton. CALLIVOIRE

This product is widely used in the storage of maize intended as food in periods of high production, while in periods of low production the maize is quickly sold for economic reasons.

2. Results of analysis

2.1. Presentation of results

Analysis of the various samples of rice and maize carried out in CPG showed the presence of residues of organochlorine pesticides. The results of analysis are given in Tables VI, VII, VIII and IX, and also represented in Figures 1, 2 and 3.

Table VI: Average concentrations of residues (in ppm) in samples of rice according to warehouse

Family	Residue	W1	W2	W3	W4	W5	W6	W7	MRL (ppm)
Organochlorines	α-Endosulfan	0.2035	0.2283	0.1149	0.3087	0.2656	0.2779	0.1036	0.1
	Dieldrin	0.0252	0.0163	0.0132	0.0076	-	0.0078	-	0.2
	β-Endosulfan	0.6126	0.6692	0.8411	0.4643	0.8345	0.5328	-	0.1
	PP-DDE	0.0372	0.0551	0.046	0.16	0.051	0.0476	0.0265	0.1
	PP-DDT	-	0.0034	0.0034	0.0028	-	-	-	0.1
	OP-DDD	-	-	-	-	0.0191	0.0269	0.03	0.1

Table IX: Concentrations of residues (in ppm) for rice and maize

Residue	Rice	Maize	MRL (ppm)
Lindane	-	0.057	0.5
α-Endosulfan	0.2059	0.063	0.1
Dieldrin	0.0114	-	0.2
β-Endosulfan	0.5036	0.0053	0.1
PP-DDE	0.0576	0.0163	0.1
PP-DDT	0.001	-	0.1
OP-DDD	0.0114	0.0122	0.1

Abbreviations used in the above tables:
W = warehouse
MRL = Maximum Residue Limit fixed by the FAO/OMS Codex Alimentarius

Figure 1: Histogram showing distribution of organochlorine residues in rice according to origin

Figure 2: Histogram showing distribution of organochlorine residues in maize according to warehouse

Figure 3: Histogram showing distribution of organochlorine residues in rice and maize

2.2. Analysis of results

In general terms, the residues found in rice and maize samples belong to various groups of the organochlorine family:

- Alpha- and Beta-Endosulfan from the group of Terebenthine essence derivatives, which belongs to the Cyclodiene group;
- PP-DDE, PP-DDT and OP-DDD from the DDT (Dichlorodiphenyltrichloroethane) group;
- Dieldrin, which is found only in rice, from the Cyclodiene group;

- Lindane, which is found only in maize, from the Gamma-HCH (Hexachlorocyclohexane) group.

The rice showed high concentrations of Alpha- and especially Beta-Endosulfan in terms of origin as well as warehouse. These various concentrations are above the limits for Alpha- and Beta-Endosulfan and below those for other residues (Dieldrin, PP-DDE, PP-DDT and OP-DDD). However, Uncle Ben's Rice, which was used as a control, has Alpha- and Beta-Endosulfan and PP-DDE in concentrations below the maximum limits, and thus respects the norms.

The maize showed residue concentrations that varied according to warehouse:

- Lindane in two warehouses (8 and 12);
- Alpha-Endosulfan in all the warehouses in concentrations below the limit, except for warehouse 9, where the concentration was 0.1145, thus slightly above the limit of 0.1;
- Beta-Endosulfan in two warehouses (11 and 12);
- PP-DDE in three warehouses (8, 9 and 14);
- OP-DDD in two warehouses (14 and 16).

All these concentrations are below the Codex norms.

Our analysis also shows that rice is in general more contaminated than maize.

II. DISCUSSION

The residues found after analysis belong to the organochlorine family. The analysis of rice shows high concentrations of Alpha- and especially Beta-Endosulfan, which are over the maximum limits of the Codex, in terms of both warehouse and origin, and whether imported or locally grown. This could coincide with the information obtained from our survey of rice warehouses, which discovered that the latter had used physical and not chemical methods to conserve stocks.

The strong presence of Endosulfan would certainly be a result of contamination brought in from the field. Endosulfan is widely used as an insecticide to control cochineals, aphids, beetles and borers, which attack rice during its growing period. The high concentrations would be the result of incorrect use (waiting periods not respected, misuse of a given product etc.). Pesticides behave in two ways with plants, either remaining on the surface of the plant and thus being external, or acting inside the plant and thus being systemic (BOUA 1996).

Organochlorines are the most persistent pesticides, and could thus be found in rice grains after treatment at some unspecified time in the past, for example when the plants were coming into ear, through the bio-concentration phenomenon (the direct increase in the concentration of a pollutant as it passes from the air or soil into the plant through the leaves or roots: RAMADE 1992).

RAMADE's work has shown that organochlorine insecticides are often responsible for large-scale mortality among various species of bird. These high concentrations of organochlorines represent a serious danger and a challenge to us, for they can be like a time bomb, leading to the appearance of behavioural or reproductive disorders or malformations (DEMDELE 1992).

Although the concentrations of residues found in maize are below the Codex Alimentarius limits, they also represent a challenge, not only because the concentrations vary from one warehouse to another, but also because of the presence of Lindane. This is in line with the information gathered during our survey, which showed that some warehouse owners or managers do not use products recommended for storage, but prefer Calthio, containing Lindane, which is advocated for conserving seed and is generally supplied illegally by cotton growers. This is why the use of agrochemicals needs to be strictly controlled.

Republic of Côte d'Ivoire
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Dissertation for the degree of Master of Science
Specialization: PLANT AND ENVIRONMENTAL PROTECTION

Subject:
STUDY OF THE QUALITY OF WATER IN THE KORHOGO FISHPONDS

Presented by:
EHOUSSOU KOUAME MARCOSSE

Supervised by:
Dr DEMBELE ARDJOUMA
Dr TRAORE KARIM SORY

Korhogo, 2001

I. RESULTS

Analysis of the physical and chemical properties allowed us to determine the temperature, pH, and content of certain elements such as ammonium, nitrates, phosphates, oxygen and carbon dioxide in the water of four ponds and the river. The results are given in Table V, together with the EPA norms.

Chromatographic analysis carried out in CPG showed the presence of organochlorine pesticide residues in various matrices (water, sediment) for Ponds 1, 2, 3 and 4 and the river, as well as in fish (in Ponds 1 and 2) and fish feed. The results are given in Tables VI, VII, VIII and IX, and represented in Figures 1, 2, 3 and 4.

Table V: Physical and chemical properties of water in the four ponds and the river

Test (measurement)	Pond 1	Pond 2	Pond 3	Pond 4	River	EPA norm
Temperature (^{0}C)	25.5	26.2	25.1	15.2	25.3	22-28
pH	7.5	7.5	7	7	7	6-9
Ammonium (mg/l)	0	0	0.2	0.2	0	
Ammoniac (mg/l)	0	0	0.001132	0.001132	0	<0.02
Nitrates (mg/l)	25	25	50	50	25	
Oxygen (mg/l)	12.2	12.6	10.2	10.8	13.4	
Oxygen saturation (%)	155.09	162.9	129.2	136.9	171.18	>70
Phosphates (mg/l)	0.5	0.5	2	0.5	0.25	<0.3
Nitrites (mg/l)	0.025	0.025	0.025	0.025	0	<0.3
Total hardness (mmol/l)	0.6	0.6	0.7	0.7	0.4	
Carbonated hardness	1.2	1.1	1.4	1.4	1	
Carbon dioxide (mg/l)	4.44	4.44	16.8	16.8	3.7	<5

Table VI: Pesticide residues in various matrices (water, sediment, fish, fish feed) for Pond 1

Residue	Water	Sediment	Fish	Contaminated fish (%)	River	Fish feed
α-HCH		0.0028	0.0011	25		
Lindane		0.005	0.0293	25		0.1016
Heptachlor	0.0006		0.0168	50		
Aldrin	0.0013	0.1321	0.2725	25		
Isodrin			0.2385	75		
Sulphur	0.004	4.55419	0.3148	100	0.0091	0.1147
OP-DDD			0.158	50		
Trans-hep-epo	0.0006				0.0009	
β-Endosulfan		0.1484	0.0409	75		0.6956
PP-DDD	0.0011		0.015	25	0.0001	
OP-DDT	0.0007		0.024	50	0.001	0.0187
PP-DDT		0.0054	0.0052	50		
Methoxychlor			0.0101	25	0	
PCB180			0.0319	25		0.015
Endrin	0.0024					
Endosulfan-sulfate	0.0018	0.0138	0.0024	50		0.0307
PP-DDE						0.0755
Trans-chlordane	0.0013	0.0221				
HCB	0.0009	0.0029				0.231
α-Endosulfan		0.0651	0.8038			

Dieldrin		0.0038				

Table VII: Pesticide residues in various matrices (water, sediment, fish, fish feed) for Pond 2

Residue	Water	Sediment	Fish	Contaminated fish (%)	River	Fish feed
α-HCH		0.024				
ε-HCH			0.0905	25		
Lindane		0.3307	0.0011	25		
Heptachlor		0.0491	0.0152	25		0.1016
Sulphur	0.005	2.5897	0.0524	25	0.0091	
OP-DDD			0.0169	100		
Trans-hep-epo			0.0032	50	0.0009	
β-Endosulfan		0.1279	0.0027	25		0.6956
PP-DDD	0.0013		0.0037	25	0.0001	
OP-DDT					0.001	0.0187
PP-DDT		0.0064	0.0067	75		
Methoxychlor			0.0131		0	
PCB180	0.0013	0.0353	0.0061	25		0.015
Endrin	0.0027					
Endosulfan-sulfate	0.0032		0.0022	50		0.0307
PP-DDE			0.0248	25		0.0755
Trans-chlordane			0.0049	25		
HCB		0.0011				0.231
α-Endosulfan		0.0909				
Dieldrin		0.0038				

Table VIII: Pesticide residues in various matrices (water, sediment, fish feed) for Pond 3

Residue	Water	Sediment	River	Fish feed
Lindane	0.0001			0.1016
Sulphur	0.0051	7.1886	0.0091	0.1147
Trans-hep-epo	0.0007		0.0009	
β-Endosulfan		0.0513		0.6956
PP-DDD	0.0012		0.001	
OP-DDT	0.0008		0.001	0.0187
Methoxychlor	0.0018	0.0099	0	
PCB180	0.006	0.098		0.015
Endosulfan-sulfate				0.0307
PP-DDE				0.0755
Trans-chlordane	0.0015			
HCB		0.0749		0.231

Table IX: Pesticide residues in various matrices (water, sediment, fish feed) for Pond 4

Residue	Water	Sediment	River	Fish feed
α-HCH		0.0324		
Lindane	0.0001			0.1016
Sulphur	0.0055	11.7639	0.0091	0.1147
Trans-hep-epo			0.0009	
β-Endosulfan		0.1477		0.6956
PP-DDD			0.0001	
OP-DDT	0.0009		0.001	0.0187
PP-DDT		0.0048		

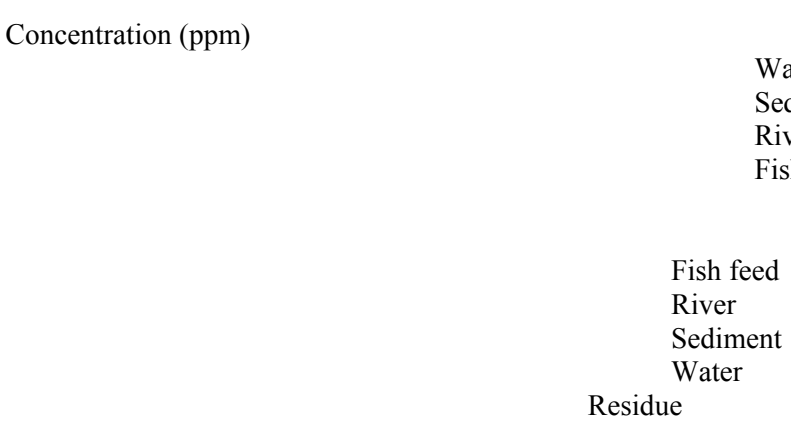
Methoxychlor			0.0021	
PCB180	0.0008	0.1294		0.015
Endrin				
Endosulfan-sulfate	0.0034	0.0102		0.0307
PP-DDE				0.0755
HCB		0.0749		0.231

Figure 1: Residue concentrations in various matrices for Pond 1

Figure 2: Residue concentrations in various matrices for Pond 2

Figure 3: Residue concentrations in various matrices for Pond 3

Figure 4: Residue concentrations in various matrices for Pond 4



II. ANALYSIS OF RESULTS

Analysis of the physical and chemical properties of the water of the various ponds showed the following:

- the temperature and pH of the water in the four ponds and the river meet EPA norms for life in an aquatic environment;
- ammonium and nitrites are present in only very small amounts in the water of the four ponds and the river;
- nitrates and phosphates are present in relatively high concentrations in all the water studied;
- oxygen saturation is very high throughout the farm (ponds and river);
- the concentration of carbon dioxide is lower in the water of Ponds 1 and 2 and the river (<5mg/l) than in that of Ponds 3 and 4 (>5mg/l).

For all the elements analysed, concentrations in Pond 1 are very similar to those in Pond 2, and also close to those in the river, whereas those in Pond 3 are closer to those in Pond 4. Concentrations of carbon dioxide and oxygen vary inversely in all the water analysed.

Chromatographic analysis allowed us to determine the content of organochlorine compounds in the various matrices (water, sediment, fish, fish feed) in the ponds and the river. Three major pesticide groups were identified:

- the Hexochlorocyclohexane group: Alpha-, Beta-, Epsilon- and Delta-HCH;
- the DDT group and its derivatives: Lindane, PP-DDT, OP-DDT, PP-DDD, OP-DDD;
- the Cyclodiene group: Aldrin, Endrin, Dieldrin, Methoxychlor, Trans-chlordane, Alpha- and Beta-Endosulfan.

The concentration of these elements is generally higher in sediment than water in all the four ponds and the river.

Most of the elements found in fish are also found in the water and/or sediment and in the fish feed. However, certain elements are found only in fish, for example OP-DDD and Methoxychlor in Pond 1, and Alpha-HCH, PP-DDE and Trans-chlordane in Pond 2.

Similarly, certain elements that are found neither in the water nor in the fish feed are found in the sediment, for example Alpha-HCH, PP-DDT and Beta-Endosulfan in Pond 2.

III. DISCUSSION

A. PHYSICAL AND CHEMICAL PROPERTIES

Temperature and pH would not appear to be limiting factors for the development of fish in any of the ponds analysed in our study. The pH between 7 and 7.5 and the temperature between 27° and 31ºC meet EPA norms for freshwater species. Such a pH is favourable to the life of a number of aquatic species such as carp (for fish) and nitrifying and denitrifying bacteria such as azotobacteria, or nitrosomas. Temperature has a direct effect on the quantity of dissolved oxygen, so that the quantity decreases as the temperature rises, making life difficult for less tolerant species, which may sometimes disappear (FAURIE, C. et al. 1998). Only small quantities of ammonium and nitrites are found on the farm.

Nitrates and phosphates are found all over the farm in concentrations higher than the EPA norms for freshwater life. Run-off carries these elements into the ponds from simple fertilizers (nitrogen, phosphate) or compound fertilizers (N-P, N-K, N-P-K) used on crops. Concentrations of these elements in the ponds is rising considerably, maybe as a result of the quasi-stagnant nature of the water in them (QUINIO, J. 1981), or the influx of matter of animal or plant origin from fish feed, or even the decomposition of the vegetation growing around the ponds.

The often greater accumulation of some of these compounds in Ponds 3 and 4, where fish farming is combined with poultry rearing, may be a result of the influx of matter from the birds' faeces or their feed, which is basically of vegetable origin (rice and maize bran).

Concentrations of oxygen and carbon dioxide vary almost inversely in all the ponds. Organic matter (fish feed, bird faeces, plant debris etc.) introduced into the ponds uses the water's oxygen as it decomposes, entailing in particular the production of carbon dioxide (ARRIGNON 1998). The lack of oxygen is indeed the main cause of the death of fish in systems where the pond has been over-fertilized or over-nourished (HILBRANDS et al. 1996).

REPUBLIC OF CÔTE D'IVOIRE
Union – Discipline – Labour

COUNTRY PROFILE TO EVALUATE NATIONAL CAPACITIES TO MANAGE CHEMICALS

prepared under the auspices of
the National Directorate of the Environment

with the assistance of
the United Nations Institute for Training and Research (UNITAR),
the Inter-Organization Programme for the Sound Management of Chemicals (IOMC)
and
the Secretariat of the Intergovernmental Forum on Chemical Security (IFCS)

Abidjan, March 1997

National Coordinator: ***Mr Dakouri Raphaël ZADI***
Service Chief, General Regulation of the Environment
Member of the Ozone Bureau of Côte d'Ivoire

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Chapter 3: Priority problems concerning the production, import, export and use of chemicals

Côte d'Ivoire has a relatively large need for chemicals to meet its domestic requirements. Such products used in the agricultural, industrial and mining sectors etc. pose some major problems concerning their management (production, importation, use etc.) (see Table 3a).

Table 3a: Nature of the problems

Nature of problem	Town/Region	Short description of problem
Poor handling of pesticides	Country-wide	Handlers are mainly illiterate, so do not observe precautions for use
Misuse of pesticides	Country-wide	Products are diverted from their main use for other, unrecommended purposes; e.g. certain unsuitable preparations are used to kill fish or for hunting
Use of empty packaging from chemicals	Country-wide	In rural areas, agrochemicals are stored in places where livestock and people sleep alongside foodstuffs; there are also defective containers that allow spillage of the product
Production of workers in industrial and mining companies	Country-wide	Lack of proper equipment for the products
Use of chemicals in industrial and mining companies	Country-wide	Negligence in handling and in the use of the scarce equipment available
Capacities for reaction in an emergency	Country-wide	Poor knowledge of how to handle control equipment in an emergency

Table 3b: Priority problems concerning chemicals

Nature of problem	Scale of problem	Level of concern	Capacity to control problem	Availability of statistical data	Specific chemicals causing problem	Priority rating
Air pollution	Country-wide	High	Low	Not available	DDT, Lindane, Cyclopentadiene, Chlorides, Ferons	High
Pollution of navigable waterways	Country-wide	High	Low	Insufficient	No3, Po4, heavy metals, DDT, pesticides, Dioxin	High
Sea pollution	Local	Medium	Low	Insufficient	Fats, PCB, No3, Po4, DDT, maintenance products, hydrocarbons	Medium
Pollution of water table	Country-wide	High	Low	Insufficient	No3, DDT, Dioxine, organochlorines	Low
Soil pollution	Country-wide	Low	Low	Not available	No3, Po4, fats, maintenance products, emptying of drains, pesticides, various hydrocarbons	High
Pesticide residues in food	Country-wide	High	Low	Insufficient	Persistent pesticides, organochlorines	High
Contamination of drinking water	Country-wide	Medium	Low	Insufficient	PCB	Low
Treatment of dangerous waste/disposal of waste	Country-wide	High	Low	Insufficient	Various chemicals	High
Agricultural workers' health	Country-wide	High	Low	Not received	DDT, Lindane, Dieldrin, Aldrin, etc.	High
Industrial workers' health	Country-wide	High	Low	Insufficient	All industrial and consumer chemicals	High
Public health	Country-wide	High	Low	Medium	Carcinogens, heavy	High

(toxology)					metals, teratogens, Diethylstilbestrol, mutagens	
Accidents with chemicals: industrial	Country-wide	High	Low	Medium	Asbestos, lead	Low
Accidents with chemicals: transport	Country-wide	Low	Low	Medium	Lindane, DDT, HCH, Dioxine, pesticide residues	Low
Importation of unknown chemicals	Country-wide	High	Low	Not available	All other chemicals	High
Storage/disposal of expired chemicals	Country-wide	High	Low	Medium	Products of oxidation, reduction and toxic degradation	High
Poisoning caused by chemicals	Country-wide	High	Low	Medium	All chemicals and agrochemicals	High
Persistent organic pollutants	Country-wide	High	Low	Not available	POPs	High
Other						

Annex IV: List of active substances and certification situation in Côte d'Ivoire

Active substance	Registered on PIC list	Registered on PAN list	Certification situation of products containing active substance in Côte d'Ivoire
Aldrin	Yes	+	Not certified
Aldicarb	No	+	Conditionally certified[1]
Camphechlor (Toxaphene)	No	+	Not certified
Captafol	Yes		Conditionally certified[2]
Chlordane	Yes	+	Not certified
Chlordimeform	Yes	+	Not certified
Chlorobenzilate	Yes		Not certified
DBCP	No	+	Not certified
DDT	Yes	+	Not certified
Dieldrin	Yes	+	Not certified
Dinoseb	Yes		Not certified
EDB	Yes	+	Not certified
Endrin	No	+	Not certified
Fluoroacetamide	Yes		Not certified
HCH	Yes	+	Not certified
Heptachlor	Yes	+	Conditionally certified[3]
Lindane	Yes	+	Certified
Mercury	Yes		Not certified
Methamidophos	Yes[4]		Not certified
Monocrotophos	Yes[4]		Conditionally certified[1]
Paraquat	No	+	Certified
Parathion-Ethyl	Yes[4]	+	Certified
Parathion-Methyl	Yes[4]	+	Certified
Pentachlorophenol	Yes	+	Not certified
Phosphamidon	Yes[4]		Not certified
2,4,5-T	Yes		Not certified

[1] Application is restricted to a specialized team.
[2] Use is restricted to treatment in rubber growing.
[3] Use is restricted to treatment of cotton seed.
[4] The PIC procedure is applied for certain preparations.

PIC = FAO/UNEP Procedure for Prior Informed Consent
PAN list = the "Dirty Dozen" active substances list of the international NGO Pesticide Action Network
Source: Directorate of Plant Protection and Quality 1998.

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SOCIO-ECONOMIC ANALYSIS OF THE PESTICIDE SECTOR IN CÔTE D'IVOIRE

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REPUBLIC OF CÔTE D'IVOIRE
Ministry of Agriculture and Livestock
Directorate of Plant Protection and Quality

5.1. Ivorian legislation on plant protectants

Since Côte d'Ivoire opened up to international trade (the country's export earnings from agricultural produce in general amount to 66 percent of overall earnings), it has acceded to international agreements on pesticides, in particular the FAO Code of Conduct and the Principle of Prior Informed Consent (PIC). The Ministry of Agriculture and Livestock observes the recommendations of FAO and WHO concerning the use of plant protectants so far as possible.

Legislation in Côte d'Ivoire on the use of pesticides started in 1974 with the publication of Decree 74-388 of 7 August 1974 on the certification of pesticides. In 1989, this decree was abrogated by Decree 89-02 of 4 January 1989 on the certification, manufacture, sale and use of pesticides, which takes account of the developing activities of professionals (pesticide retailers and applicators) and FAO's recommendations on agropharmaceutical products.

A pesticide is defined as follows by Ivorian law:

- any substance or combination of substances intended either to deter, destroy or control pests, vectors of human or livestock diseases and undesirable species of plant or animal that cause damage or are otherwise harmful during the production, processing, storage, transport or marketing of foodstuffs, agricultural produce, timber, wood products or livestock feedstuffs, or to be applied on livestock to control insects, arachnids and other ectoparasites;
- regulators of plant growth, defoliants, desiccative agents, fruit thinning agents, agents intended to prevent fruit from falling prematurely, and substances applied to crops before or after harvesting to protect produce against deterioration during storage or transport.

5.2. Legislation on conditions for the use of pesticides

5.2.1. Obligations prior to use

Any pesticide must receive official certification or provisional sales authorization prior to its use in Côte d'Ivoire. The certification order is valid for a five-year period, while provisional sales authorization has a two-year validity.

Only the research institutes of the Ministry of Scientific Research and laboratories and research stations of phytosanitary companies may carry out experiments using pesticides that have not yet received certification or provisional sales authorization. Such experiments must be declared in advance to the Pesticide Committee, which may in due course order the destruction of crops grown on experimental plots. Prior authorization from the Ministry of Agriculture based on the recommendation of the Pesticide Committee is required for the importation for experimental purposes of pesticides that have not received certification or provisional sales authorization. If an organization or trader wishes to import a product on the PIC list, a note is generally sent to the Ministry of the Environment or the Ministry of Agriculture for information. The note is then forwarded to the Directorate of Plant Protection and Quality, which prepares a note for the minister's signature to explain the situation and allow appropriate decisions to be taken (e.g. the case of Hexane in January 1998).

5.2.2. The Pesticide Committee

Certification and provisional sales authorization are granted through an order of the Minister of Agriculture and Livestock, based on the recommendation of an interministerial committee entitled the Pesticide Committee. The Chairman of this committee is nominated by the Minister of Agriculture and Livestock, while a Permanent Secretariat is provided by the Directorate of Plant Protection and Quality (see Annex III for the organizational chart).

The following nominate representatives as members of the Pesticide Committee:

- the Ministry of Agriculture and Livestock
- the Ministry of Higher Education, Scientific Research and Technological Innovation
- the Ministry of Finance
- the Ministry of Trade
- the Ministry of Housing, Living Conditions and the Environment
- the Ministry of Health
- the Ministry of Internal Security
- the Ministry of Defence
- the Ministry of the Plan and Industry

There is also a permanent observer from the Compagnie Ivorienne de Développement des Textiles.

7. EFFECTS ON THE ENVIRONMENT AND HEALTH LINKED TO THE USE OF PESTICIDES

7.1. Environment

7.1.1. Structures

The Directorate of the Environment of the Ministry of Housing, Living Conditions and the Environment is responsible for developing the policy for natural resource protection and defining the type and level of intervention. Other ministries initiate specific intervention measures in this connection.

Three intervention levels are mentioned:

♦ *Monitoring of environmental quality*

The Ivorian Anti-Pollution Centre (CIAPOL) monitors surface water through a National Observation Network that has 28 sampling stations on three major rivers, the lagoon and coastal areas. The information gathered covers certain pesticides belonging to the organochlorine group. Although the country is poorly covered by such sampling, the programme provides the only systematic evaluation of pesticide residues in the aquatic environment.

The Korhogo Ecology Laboratory (LABECO) of the National Laboratory for Support to Agricultural Development carries out analyses of residues in various environments for a number of organizations, and of plant protectants for the Compagnie Ivorienne de Développement des Textiles and the Directorate of Plant Protection and Quality (for certification of products). There is also collaboration with research institutes and universities.

♦ *Research on environmental contamination in specific cases*

The Oceanographic Research Centre has carried out analyses of the contamination of water, sediment and aquatic organisms over a number of years. The National Laboratory for Quality Trials, Metrology and Analysis is at present carrying out a study on the contamination of natural resources in two areas (the cotton- and cocoa-growing zones).

♦ *Monitoring of production, preparation, distribution and application conditions for plant protectants*

A division of the Ministry of Housing, Living Conditions and the Environment is responsible for monitoring industrial installations, including factories preparing plant protectants in the port area of Abidjan, and installations for the treatment of waste water and industrial waste.

The Directorate of Plant Protection and Quality is responsible for certifying products, retailers and applicators of plant protectants and for monitoring sales establishments (see Chapter 5).

7.1.2. Present status of contamination of natural resources

Contamination of water by chemicals often leads to a biological build-up in fish and other aquatic organisms, sometimes in biologically active concentrations. Residues of plant protectants found in water, sediment, fish and other aquatic organisms can constitute a danger to other aquatic organisms, their predators and human beings.

Among pesticides, most substances in the organochlorine group are well known for their persistence and for building up in the food chain. After several decades of use all over the world, these pesticides are now ubiquitous, often without any precise knowledge of the source of contamination.

Analysis of the aquatic environment in Côte d'Ivoire clearly shows that organochlorines are often found in considerable concentrations (see Annex VII). Almost all samples are contaminated with various substances. Most samples of surface water contain traces of organochlorines, especially Lindane. Although the level of contamination of surface water is generally not too high in comparison with other regions of the world, there are some hot spots where contamination with certain residues is high.

Organochlorine residues are also found in sediment from rivers, lakes and the Abidjan lagoon. Analysis of the nine samples from Buyo, Guessabo and N'zo showed that all the sediment contained residues of Lindane, Epsilon-HCH, Heptachlor, Aldrin and Dieldrin, while two-thirds also contained OP-DDT (LABECO 1996; see Annex VII). In the same areas, all the 45 systematically obtained samples of fish contained residues of several organochlorines, and two-thirds had residues of one or more organochlorines that were above the maximum limits (see Table 7.1).

Table 7.1: Sampling of fish with residues in the Buyo, Guessabo and N'zo areas

Pesticide	Concentration of residues (in ppm)	Number of samples containing residues (total: 45)	Maximum residue limit (mg/kg)*	Number of samples above the maximum residue limit (total: 45)
α-HCH	0.0000-0.8075	27	0.2	27
Lindane	0.0000-0.4076	36	0.5	0
ε-HCH	0.0000-0.3035	26	0.2	3
Heptachlor	0.0000-0.0419	40	0.2	0
Aldrin/ Dieldrin	0.0000-0.7105/ 0.0000-0.0428	45/ 40	0.2	1
OP-DDT/ PP-DDT	0.0000-0.0403/ 0.0000-0.6115	25/ 27	5	0
Total		45/45		30/45

* European Union limit. The limits of the WHO/FAO Codex Alimentarius have not yet been defined.
Source: Calculations based on LABECO data (1996).

These results are confirmed by LABECO's analysis of other samples over a number of years. Apart from organochlorines, high residues of organophosphates have been found, especially Parathion-ethyl. Saltwater fish generally contain small traces of organochlorines.

Analysis of organochlorine residues in the soil shows differences between farms. While the horticultural zone has very little contamination, the banana and cocoa zones all have traces of several pesticides (see Table 7.2 and Annex VII). The soil on cocoa farms is contaminated especially by Lindane, while traces of old organochlorines (Aldrin, Dieldrin, Endrin) are found in the banana zone at higher concentrations in lower than upper layers.

Table 7.2: Percentage of soil samples with organochlorine residues in two layers

Pesticide	Cocoa zone	Banana zone	Horticultural zone
α-Endosulfan	50	0	0
Lindane	90	80	30
Heptachlor	100	100	3
Aldrin	80	100	70
Dieldrin	80	80	10
Endrin	0	70	0
OP-DDD	40	0	0
Total	100	100	70

Source: Calculations based on LABECO data (1997).

7.1.2. Outlook

The above analyses of residues do not allow an appreciation of the real impact of environmental contamination linked to the use of pesticides. Fuller field studies are clearly needed in areas with a heavy use of pesticides in order to identify long-term risks. Regular monitoring of environmental effects should also be taken into account when certifying plant protectants. With regard to the monitoring of phytosanitary companies' plants and distributors' premises, old facilities need to be renovated in order to minimize pollution risks (point pollution).

In the long term, the contamination of natural resources can have economic costs (for example for the rehabilitation of drinking water resources), as well as a negative impact on development of the tourist sector. Although the costs cannot yet be estimated, the importance of setting up a data network for the various environments should be noted.

7.2. Health

7.2.1. Structures

With regard to the effects of the use of plant protectants on human health, the National Laboratory for Public Health is the public body responsible for the monitoring and control of public health problems, as well as the prevention and analysis of cases of poisoning. However, it should be noted that the laboratory has no general policy concerning monitoring and prevention in the use of plant protectants: no systematic control is exercised concerning pesticides for lack of resources, and most analyses are carried out on the request of such structures as phytosanitary companies (such requests are rare) and the courts in case of a complaint's being lodged.

There is also the Department of Labour Medicine at the University Hospital Centre in Yopougon, which monitors professional health problems, i.e. cases of poisoning in the work place.

UNIPHYTO organizes fora for experts, with a view to improving working conditions on plantations and in companies. It also organizes training courses for users, distributors, applicators and rural doctors in collaboration with the Directorate for Plant Protection and Quality.

7.2.2. Various types of poisoning risk from plant protectants

Plant protectants represent a danger of poisoning for human health. Various types of poisoning can appear:

♦ *Acute poisoning*

Cases of acute poisoning are localized accidents. For example, the University Hospital Centre in Yopougon recorded ten cases in 1997, including one collective poisoning that led to the death of seven members of a family in Dabou. These people had eaten pesticide-contaminated bushmeat. There are many occurrences, but very few are reported.

Problems arise in the following cases:
- suicide through the consumption of plant protectants;
- accidents during application;
- accidents in the case of rain, which drains freshly applied products into the watercourses used by the inhabitants (drinking, children swimming and playing, watering of foodcrops etc.);
- criminal poisoning (for example, the introduction of pesticides into local whisky);
- application of pesticides on the skin in order to avoid insect bites and stings.

♦ *Chronic poisoning*

Chronic poisoning is the most serious and frequent type. It takes place after long-term contact with plant protectants, and can affect factory workers who inhale them regularly or planters and applicators who use them regularly. The effects appear only later and are usually irreversible. Two cases of this type can be cited:
- the case of two workers in ornamental horticulture, whose nervous systems were affected; their case was submitted to the National Social Security Fund as a professional disease;
- the case of a Compagnie Ivorienne de Développement des Textiles worker who handled seed (application of plant protectants).

Only 5 to 10 percent of the 800 cases of poisoning recorded by the National Laboratory for Public Health in Abidjan each year concern pesticides. Very few cases of death are reported, and only one such case due to pesticides on a plantation has been recorded. Doctors believe that there are more cases than recorded in the statistics because the areas where pesticides are used are a long way from the National Laboratory for Public Health, while other hospitals do not report their figures. Moreover, in rural areas not everybody will go to hospital in such a case. Among the cases mentioned was one in Ferké where several people, mostly children, were poisoned by water from a lake.

The laboratory charges about CFAF 50 000 for analysis of blood from a poisoned individual. The real cost to be paid without this implicit subsidy would be between CFAF 150 000 and 200 000, but despite this reduction in charges, the laboratory receives few requests for analysis.

At the University Hospital Centre, costs vary depending on the type of poisoning:
- acute: CFAF 200 000 per day for at least seven days of hospitalization = CFAF 140 000;
- chronic: one to three months of supervision, plus CFAF 5 000 per consultation with the various analyses.

A recent West Africa Rice Development Association and Hanover University study in two areas in the cotton-growing zone provided data on the impact of pesticide use on the applicators' health. One site, Korhogo, has areas where pesticides have been used over a long period, whereas in the other site, Katiola/Niakara, cotton has been introduced only recently (a development zone).

Twenty percent of farmers who had applied pesticides during the 1997/98 growing season had one or more symptoms of poisoning, with the following being recorded: headache, 25 percent of applicators with symptoms; cold, 18 percent; cough, 17 percent; itching, 13 percent; sneezing, 11 percent; other symptoms, 16 percent (communication from Ajayi, 1998).

The effects of pesticide – especially insecticide – application led to an average loss of 0.66 working days per farm. There was also an average of 5.02 days when the pesticide applicator was only partially able to work. The calculation of the costs of lost working days in the cotton sector is shown in Table 7.3, and follows the data gathered by Ajayi (1998). Farms in the cotton-growing zones suffer a total loss of about CFAF 115 million in opportunity costs. These costs amount to about 1.5 percent of the total value of plant protectants used in the cotton sector.

Apart from opportunity costs, there are the costs of purchasing medicine and of transport to hospital for some applicators. Farmers also make use of local medicine.

Table 7.3: Costs of pesticide poisoning in the cotton sector (opportunity costs of loss of working capacity)

• number of working days lost per farm:		
- total loss	0.66	
- partial loss	5.02	
• size of farm (hectares of cotton declared to the Compagnie Ivorienne de Développement des Textiles)[1]		2.96
estimated loss of working days for the area under cotton in 1997/98: (0.66 + 5.02*0.33)/2.96*244 000 ha		192 200 days
• daily wage in cotton-growing zones		CFAF 600
• opportunity costs of loss of working capacity		CFAF 115.3 million

[1] The real area was 3.29 ha.
Source: calculation based on data from the Ajayi survey (1998).

7.2.3. Residues in foodstuffs and drinking water

The presence of plant protectant residues in food and water constitutes a danger to human health. To date, there has been no systematic monitoring of foodstuffs to assess their residue content. However, certain practices could foster the presence of residues, particularly the following:

- poor handling during use;
- ignorance of rules for use;
- contamination of watering points (wells) that are used daily by people for drinking water;
- residues contained in fish or other products fished in waters contaminated by rainwater run-off carrying plant protectants.

The contacts and information made available to the team can be summarized as follows:

- there are some studies carried out by students, which provide pointers as to residues, particularly of organochlorines and organophosphates, in samples of coffee and cocoa; this research should be taken up by laboratories and research experts;

- a sampling of well water in rural areas showed the presence of residues, and traces of Malathion and Lindane were also found; although the quantities are below the toxicological threshold, they are above the limits adopted by the European Union;
- over a 12-month period in 1988/89, the National Laboratory for Public Health took 38 samples of food for which analysis had been requested, and five of these samples contained residues.

7.3. Conclusion

Although sufficient data on the contamination of natural resources are not yet available, it is clear that the use of plant protectants can cause long-term risks. It should be pointed out that a major intensification could aggravate contamination of resources, with impacts and costs that cannot be estimated at present. Moreover, these effects are not yet taken into sufficient account in strategies for the use of such products.

The National Laboratory for Public Health, which acts as the focal point for the International Programme on Chemical Security, requires more resources for carrying out analyses and acting as an advice and information centre for cases of poisoning. One line of action, for example, would be revival of the poison telephone helpline. A national network for the sampling and systematic monitoring of foodstuffs and drinking water should also be established.

Annex VII: Contamination of the aquatic environment with organochlorines: average concentrations

Matrix and site	Lindane	Aldrin	Endrin	Dieldrin	Heptachlor	DDE	Year and source
Surface water (µg/l):							
Abidjan lagoon	0.22		0.27	0.01	0.2	0.1	1995/96, NON
Rivers	0.3		0.00-0.1	0.00-0.3	0.01-0.2	0.00-0.01	1995/96, NON
Sediment (ppb):							
Abidjan lagoon	n.d.	70-200	n.d.	n.d.	n.d.	50-200	1995/96, NON
Rivers	1.5-15	<1	<1	<1.0	2-17	<1	1995/96, NON
Abidjan lagoon	3.0	15.7	n.d.-15.06	17.8	0.9	total DDT: 46.2	Kaba/Kouakou (1998)
	0.07-19.81	0.07-62.1		n.d.-125.8	n.d.-6.8	(2.5-242.83)	
Lake Buyo	2.6-44.6 (Lind.) 16.2-595 (ε-HCH)	3.0-82.2		3.5-9.2	1.3-20.6	n.d.-12.3 (OP-DDT)	LABECO (1996)
Oysters (ppb in dry weight):							
Abidjan lagoon	1.82-2.0		1.67-2.0	2.0-3.0	3.0-5.0	50-60.08	1996, NON
Coastal zone	<1.5		<1.5	<1.5	<1.8	<1.5	1996, NON
Boulay Island	54.4	131.94	55.63	96.54		114.75	Kaba/Kouakou (1998)
Riviera Golf	23.02	21.01	13.47	37.5		56.89	
Saltwater fish						total DDT:	
(ηg/g of dry weight)	<0.1-2.4	0.1-3.9	n.d.-<0.1	n.d.-2.1	n.d.-2.7	0.4-12.9	Kaba (1992)
Freshwater fish (ppb):						total DDT:	
Buyo	n.d.-89.2	24.1-131		n.d.-17.9	5.8-27	n.d.	LABECO (1996)
Guessabo	87-407.6	9.2-710.5		5.5.-42.8	n.d.-35.4	n.d.-42.7	LABECO (1996)
N'zo	n.d.-25	21-65		4.1-25.4	5.8-41.9	24.18-643.3	LABECO (1996)
Aby lagoon (tilapia)[1]	n.d.-20		n.d.-60	10-120	n.d.-160	n.d.-170 (PP-DDD)	1995, LABECO (1998)
Layo (fish ova)[2]				16.7			1995, LABECO (1998)
Bietry Bay[3]	n.d.-100 (Lind.) n.d.-110 (ε-HCH) n.d.-2636 (β-HCH)			n.d.-1164.9	n.d.-1.2	n.d.-859 (PP-DDT)	1996, LABECO (1998)
Upper threshold for consumption of fish	200 (Lind.) 200 (HCH)		10	100	150	500 (DDT) 250 (DDD)	LABECO (1998)
Soil samples (µg/kg)							LABECO (1997)
Upper layer:						OP-DDD:	
cocoa zone	7-16	9-23	n.d.	3.7	4-7	n.d.-10	
banana zone	n.d.-13	6-17	n.d.-8	n.d.-5	2-20	n.d.	
horticultural zone	n.d.-1	n.d.-2	n.d.	n.d.	n.d.-0.6	n.d.	
Lower layer:							
cocoa zone	n.d.-13	n.d.-7	n.d.	n.d.-12	3-4	n.d.	
banana zone	1-15	13-20	n.d.-5	n.d.-6	3-5	n.d.	
horticultural zone	n.d.-1	n.d.-2	n.d.	n.d.-1	n.d.-0.6	n.d.	

Sources: CIAPOL (1998), Kaba (1992, cited by Obisanjo 1994), Kaba & Kouakou (1998), LABECO (1996), LABECO (1997), LABECO (1998).

n.d. = not detected
NON = National Observation Network
[1] Parathion-Ethyl 210-690, Sulphur 170-290, α-Endosulfan 230-1020, β-Endosulfan n.d.-90, Malathion n.d.-470.
[2] Chlorpyriphos-Ethyl 11, Profenophos 42, Parathion-Methyl 7, Chlorpyriphos-Methyl 124, Dimethoate 30.
[3] α-Endosulfan n.d.-560, β-Endosulfan n.d.-1260.6, Endosulfan-Sulfate n.d.-1000, n.d.-19.1 (OP-DDT), n.d.-141.2 (PP-DDD).

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