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Technical report:
Partnership Workshop on the Search for Alternatives to Banned/Restricted POPs in Africa*

Prepared for the United Nations Industrial Development Organization

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EXECUTIVE SUMMARY

The Stockholm Convention on Persistent Organic Pollutants (POPs) targets 12 particularly toxic POPs which currently include eight organo-chlorine pesticides, two industrial chemicals and two industrial by-products. With funding from the Global Environment Facility (GEF), signatories to the Convention have initiated POP enabling activities to meet their obligations to the Convention. United Nations Industrial Development Organization (UNIDO) is one of the UN specialized agencies executing POP enabling activities in a number of countries.

In recognition of the fact that overall success of POP enabling activities hinges on strategic alliances to harness pre-requisite complementary strengths of key stakeholder groups, UNIDO, the International Institute of Tropical Agriculture (IITA) and the Systemwide Program on Integrated Pest Management (SP-IPM) of the Consultative Group on International Agricultural Research (CGIAR) agree to jointly facilitate POP enabling activities in Africa. The partnership focuses on the search and promotion of alternatives to banned and/or restricted POPs. As a first step, the parties convened a consultative partnership workshop at IITA-Benin, Cotonou, Republic of Bénin February 9 - 13, 2004. There were 61 participants comprising national and technical coordinators of POP enabling activities from 20 African countries, researchers from national and international research institutes in Africa, representatives of leading industry on bio-rational alternatives from France and the United States of America (USA).

Through facilitated plenary and break-out group discussions of technical presentations, the workshop identified and analysed POP constraints and opportunities including a wide range of eco-friendly options for use in the following five intervention areas:

- Agriculture and food production.
- Public and community health.
- Environment and biodiversity management.
- Construction and infrastructures
- The industry.

Participants noted with grave concern the rapid increase in the number of countries reverting or wishing to revert to DDT and some other POPs, and noted that in the continued absence of support to search for and promote alternatives, the gains of POP enabling activities will greatly be eroded. The discussions highlighted that success on alternatives to POPs is mainly rooted in the development of quality scientific capacity to accurately identify, screen, and understand biodiversity as viable sources of appropriate candidate alternatives to POPs. Inappropriate/lack of national regulatory framework for eco-friendly alternatives was identified as another major impediment to the implementation of the Stockholm Convention in the countries. In conclusion, participants urged participating Government departments to integrate the workshop outputs into national development programs, e.g., through field projects in any of the intervention areas, as practical steps to effectively address issues standing in the way of the Stockholm Convention.

SUMMARY OF RECOMMENDATIONS

On the basis of workshop activities, discussions and outputs on country-specific and cross-cutting issues that stand in the way of the search and promotion of alternatives to POPs in the intervention areas of agriculture and food production, public and community health, environment and biodiversity management, construction and infrastructures, and the industry, the workshop recommends:

1. National Governments and pertinent stakeholder groups integrate outputs of this workshop into their existing programs on POP and encourage activities to publicize achievements of this workshop as part of periodic POP awareness campaigns in their respective countries.

2. UNIDO/IITA/SP-IPM in partnership with the countries initiate the development of reliable data on technical and economic feasibility, quality of products, and international bio-safety standards as a basis to promote private-public sector partnership for local production and/or initial delivery of biologically based alternatives in the countries and eventually increase confidence in end-users to adopt these options instead of POPs (including other hazardous pesticides). The actual and potential benefits of the proposed private-public sector partnership should be measured, amongst other criteria, in terms of the ability in use of the products to a) reduce Africa's dependency on POPs and other harmful and imported pesticides; b) increase effective and safe use of these biological options to assure greater personal and environmental health benefits compared to POPs; c) increase end-user income; d) promote sustainability of the ecosystems and production systems.

3. UNIDO/IITA/SP-IPM in partnership with the countries collaborate with the African sub-regional networks (known as Locally Organized and Operated Partnerships, LOOPs) of BioNET INTERNATIONAL as the bases to address the capacity building needs that underpin the search for sustainable alternatives to POPs, particularly alternatives to the 8 POP pesticides on the list of the Stockholm Convention. The sub-regional LOOPs are in West/Central Africa, East Africa, Southern Africa and Northern Africa, and each LOOP is endorsed by the respective governments. Also, the LOOPS provide a ready made framework to integrate taxonomy capacity building with capacity building to isolate active ingredients in materials that would be screened.

4. UNIDO/IITA/SP-IPM in partnership with the countries develops programmes to develop sub-region regulatory frameworks in Africa for production, quality control, commercialization and safe and defective application of biopesticides, botanicals, biocontrol agents and other biologically based alternatives to POPs. The policy framework should include development of research capacity to provide and/or evaluate toxicology data required for biopesticides and botanicals.

5. UNIDO/IITA/SP-IPM in partnership with the countries establish effective mechanisms to monitor, evaluate and assess the impact of POPs as well as the progress and impact of alternatives to POPs. The continued existence and poor storage of stockpile of obsolete pesticides coupled with illegal trafficking of the POPs need to be addressed urgently in order to discourage widening of country requests to go back to the POPs.

6. UNIDO designates a Senior Expert who will devote time in working with the partners on the development of bankable projects for submission to potential donors, such as the Global Environment Facility (GEF). It is also recommended that technical papers and outputs out of the workshop be compiled for publication as a benchmark volume. The Senior Expert suggested above can also be tasked with the accomplishment of this target.

1. INTRODUCTION

1.1 THE FOCAL PROBLEM

Historically, global response to increasing food and shelter demands by a rapidly growing rural and urban population frequently turns to chemical industries to provide "quick fix solutions" in agriculture, health, environment sectors of national development strategies. The chemical industry has since the early 1920s provided diverse products with multipurpose uses in agriculture, medicine, industrial manufacturing, public and community health and protection of infrastructure. Many of the chemicals have contributed decisively to improve human well-being and ecosystem health.

Over the past 50 years the world has witnessed a growing "Chemical Revolution" in which chemical solutions to human development aspirations are impacting in different ways on man, livestock and the ecosystem in general. Once released into the environment, certain categories of chemicals cause toxic reactions, persist for years and threaten long-term health of man and the environment, and drift over long distances causing new ecological and health risks to populations. Most global environmental problems and issues related to Ozone Layer Depletion, Green House gases Emission/Global Warming/Climate Change, Trans-boundary Movement in Toxic Wastes, Persistent Organic Pollutants, and Biodiversity Conservation are directly or indirectly linked to chemicals. Hence chemicals are of priority global concern

The class of chemicals known as "Persistent Organic Pollutants" (POPs) are particularly of current concern to the nations of the world. The United Nations Environment Program (UNEP) defines POPs as "chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment". These chemicals are therefore significant threats to human health and the environment. The twelve particularly toxic POPs are:

- Eight (8) organo-chlorine pesticides: Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Mirex and Toxaphene.
- Two (2) industrial chemicals: Polychlorinated Biphenyls/PCBs and Hexachlorobenzene/HCB.
- Two (2) industrial by-products: Dioxins and Furans.

POP pesticides have been and are still applied directly and intentionally into the environment in agriculture, industry, public and community health, and forestry sectors. For example, about 2.6 million tonnes of DDT was used globally from 1950-1993 while the figure for toxaphene during the same period was 1.33 million tonnes. PCBs have been used mainly in electrical transformers, capacitors, hydraulic fluids, adhesives, plasticizers, heat transfer fluids, lubricants, cutting oils and fire-retardants. Global production of PCBs to date has been estimated at 1.68 million tonnes. PCBs enter the aquatic environment from industrial effluent or urban waste discharges. The industrial products are unintentional by-products produced from combustion sources and manufacturing processes such as municipal solid waste incineration, energy production, motor vehicles, smelting, bleaching of paper pulp and the manufacturing of some pesticides and herbicides. Small amounts of dioxins and the chlorinated furans are also produced naturally during volcano eruption and forest fires.

1.2 THE RESPONSE

Based on scientific evidence on the nature of threats and dangers posed by POPs to health and the environment, Governments of the world have adopted an international treaty to restrict and ultimately eliminate production, use, release and storage of POPs. The Treaty is called the Stockholm Convention on Persistent Organic Pollutants[1]. This Treaty targets 12 particularly toxic POPs for reduction and eventual elimination and establishes a system to track additional chemicals that can be classified as POPs. The Stockholm Convention recognizes that special efforts may sometimes be needed to phase out certain POPs for certain uses and seeks to ensure that this effort is made. The Convention also channels resources into cleaning up exiting stockpiles and dumps of POPs around the world. Ultimately the Convention points the way to a future free of dangerous POPs and promises to reshape reliance of the world's economy's on toxic chemicals.

The risks from continuous use of these toxic chemicals outweigh their benefits. There are, however, a number of barriers to the full implementation of the Convention. In most of Africa, national and community-level capacity to manage POP chemicals is limited by a number of factors. Also a lack of effective research and monitoring programmes (including capability for analysing POPs and their residues) leads to unreliable data sets on toxicology and levels of POPs in the environment.

[1] Source: UNEP 2002/3. Ridding the World of POPs: A guide to the Stockholm Convention on Persistent Organic Pollutants

Towards the Convention's aim to "point the way to a future free of dangerous POPs", the search and/or promotion for ecologically sound, technically effective, economically feasible, and culturally acceptable alternatives to POPs in agriculture, health and the environment as well as for industrial sub-sectors are at very low ebbs in African countries. There are limited demonstrations of available alternative options in widely variable environments and with highly variable levels of infrastructure and resources in different countries. Coupled with this, weak capacity building at all levels inherently perpetuates uninformed perceptions about unforeseen difficulties with alternative options to POPs. This will reinforce the establishment of old habits of a range of end-users to apply POPs. This case is especially important in food production and in the control of vectors of human and livestock diseases. In some other cases, high costs and long lead times of developing and assessing alternatives slow down the pace of search for workable alternatives to POPs. In almost all cases, however, the problem is further exacerbated by inadequate policy environment and weak enforcement of existing regulations to promote proven alternatives to POPs.

1.3 INCLUSIVE PARTNERSHIPS TO ADDRESS FOCAL PROBLEM

The diversity of challenges faced by countries in their efforts towards full realization of the benefits of the Stockholm Convention on POPs requires strategic alliances and functional linkages between key stakeholders groups to harness complementary strengths. As a contribution to address this problem, the United Nations Industrial Development Organization (UNIDO), International Institute of Tropical Agriculture (IITA) and the Systemwide Program on Integrated Pest Management (SP-IPM) of the Consultative Group on International Agricultural Research (CGIAR) agree to work together to facilitate POP enabling activities by focusing efforts on the search and promotion of alternatives to banned and/or restricted POPs in sub-Sahara Africa. As a first step in this collaboration, UNIDO, IITA and the SP-IPM convened a week-long workshop in February 9 -13, 2004, at IITA-Benin station (also known as the Biological Control Center for Africa) in Cotonou, Republic of Bénin.

UNIDO is the specialised United Nations Agency with a unique mandate for assisting developing countries and countries with economies in transition in their quests for environmentally sustainable industrial development. Chemicals and their management have been important topics for UNIDO's technical cooperation since the organization was formed in 1966. UNIDO provided broad sectoral support to developing and transition economy countries seeking to build indigenous chemicals industry capacity. After the

Bhopal accident in 1984, the focus of technical cooperation activities shifted towards chemical safety and occupational safety elements in all programmes, e.g., a Regional Network on Pesticides in Asia and the Pacific (RENPAP) was established by UNIDO in the 1980s.

In 1995, UNIDO along with other members of the Inter-Organization for the sound management of chemicals (IOMC) was invited to work with the Intergovernmental Forum on Chemical Safety (IFCS) and an *ad hoc* working group, to initiate an assessment of risks posed by POPs. The results of this undertaking prompted the formation of an Inter-governmental Negotiating Committee (INC) in 1998. The INC delivered the convention text for signature to the Conference of Plenipotentiaries held in Stockholm in May, 2001. UNIDO's work to reduce emissions of POPs from industry began in the 1980s and its comparative advantage in this sector was recognized by the GEF in granting UNIDO "Executing Agency with expanded opportunities" status in May, 2000. This allows UNIDO direct access to GEF financial resources for certain actions relating to the fulfilment by countries of their obligations under the Convention, including assisting countries in the so called Enabling Activities that will lead to the development of National Action Plans for the management and elimination of POPs.

IITA was founded in 1967 as an international non-governmental agricultural research institute, and as the first African link in the worldwide network of agricultural research centers known as the Consultative Group on International Agricultural Research (CGIAR) which was formed in 1971 IITA's mission is to enhance the food security, income and well-being of resource poor people in sub Saharan Africa. The institute is governed by an international board of trustees and staffed by approximately 80 scientists and other professionals from over 30 countries, and approximately 1300 support staff. Staffs are located in Nigeria (Ibadan, Port Harcourt, Abuja, and Kano), Republic of Benin, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Malawi, Mozambique, Tanzania, and Uganda. Funding for IITA comes from the CGIAR and bilaterally from national and private donor agencies.

IITA pursues a Research-for-Development approach, keeping in mind that the end-users operate within a continuum that uses a "means" (research) for an "end" (development), thereby leading to impact on both people's livelihoods and science. With this approach, IITA has a broad network of alliances or partnerships for development in African communities. IITA values networking and believes that organizations which do not always

share the same goals see the advantage of teaming-up for succeeding in their objectives. It is with this background that IITA partners with UNIDO to deliver on POP enabling activities in the development aspirations of host communities in countries served by UNIDO.

The SP-IPM is a global inter-institutional partnership program established by the CGIAR in 1996. The SP-IPM provides a facilitating mechanism for its partners to increase the quality and usefulness of integrated pest[2] management (IPM) research and outreach. IPM increases productivity while minimizing the use of POPs and costly external inputs, with corresponding benefit to human well-being and the environment. Towards this end, the SP-IPM pursues strategic alliances between researchers and pertinent stakeholder groups (e.g., government, NGO, private sector, agricultural development agencies and networks), to promote technical, communication, policy and investment environment required for greater food security and to raise incomes within a healthier environment.

The SP-IPM has its origins in the 1992 Earth Summit which recognized that attempts to raise living standards through conventional development approaches were only having a limited impact on hunger and poverty in developing countries, and that inappropriate development strategies were destroying the planet's ecological life support systems. In the 'Agenda 21' action plan of the Summit, IPM was identified as a key part of the solution to this problem, as it allows more food to be produced with minimal damage to agricultural and natural ecosystems. In 1996, as part of its response to Agenda 21, the CGIAR launched the SP-IPM. The SP-IPM has since then developed a position on the use of POPs and other synthetic pesticides (Annex 4), in line with its goal and definition of IPM.

[2] Pests = insects, mites, pathogens/diseases, weeds and other organisms that are detrimental to crop and livestock growth and productivity and to the environment.

2. WORKSHOP OBJECTIVES AND PROCEDURES

2.1 DEVELOPMENT OBJECTIVES

In the search for alternatives to POPs, a number of research and industry partners have developed biological based products which can directly replace more hazardous synthetic chemical pesticides. Some of these chemicals are now marketed by the private sector. However, many other promising products remain in the laboratory and are never used on a significant scale. In the sub-sectors of agriculture and food production, health and the environment, for example, poor understanding of the technical and regulatory aspects of biopesticide and other POP alternatives, combined with market-related forces, prevents such products from crossing the barrier from experimental to commercial level. The products do not achieve their potential to provide alternatives to POP pesticides. The development objective of the partnership workshop was therefore to help the target countries plan to overcome such barriers.

2.2 SPECIFIC OBJECTIVES

Specifically, the workshop provided a platform for inter-disciplinary discussions to:

- Analyse the problem area, identify POP constraints and existing alternatives.
- Review level of prior assistance on POP enabling activities.
- Plan for capacity building in the search/promotion of alternatives to POPs.
- Explore North-South and South-South partnership opportunities for research industry and commercial sectors to move forward pilot activities.

2.3 ACTIVITIES

The opening ceremony of the workshop was at 9 am on Monday 9th February 2004 (see Annex 1 for workshop programme) in the conference hall of IITA-Benin. Personalities present included:

- Minister of Agriculture, Animal Production and Fisheries Republic of Benin represented by his Directeur de Cabinet.
- Directeur-General of Institut National des Recherches Agricoles (INRAB).

- Director-General of the International Centre of Insect Physiology and Ecology (ICIPE)
- Directeur of IITA-Benin
- UNIDO Programme Manager of POPs Africa, UNIDO-Vienna
- UNIDO-Accra, Ghana Senior Expert on POPs and Inland Waters.
- National Project Coordinators and National POPs focal points from 16 UNIDO countries.
- Distinguished researchers from national and international research institutes and universities in Africa
- Representatives of local and international private sector involved in the manufactures and sells of pesticides and bio-pesticides.

The opening ceremony (Annex 2) included welcome speeches by the Chairman of the occasion, the Director of IITA-Benin, the UNIDO POPs- Africa Programme Manager and the workshop address by the UNIDO Representative for Ghana, Togo and Benin. The Workshop was declared officially open by the Representative of the Honourable Minister of Agriculture, Animal Production and Fisheries, Republic of Benin.

Each of the first four days activities was led with overviews and thematic papers, followed by case study presentations on country/institutional experiences and perspectives. Small group break out sessions homed in on specific issues. Except for day 1 which focused on industrial chemicals, technical presentations on each of days 2 to 4 focused on invertebrate biological control agents, biopesticides, and botanicals and as alternatives to pesticide POPs (see Annex 1). Technical papers (see Annex 3 for abstracts) were authoritative and served as information briefs to guide plenary and small group discussions and activities for participants to:

- Critically analyse key issues in the search for alternatives to POPs in Africa.
- Identify available and emerging alternatives from research and industry, and related capacity building needs and opportunities to promote the alternatives.
- Highlight biodiversity as natural sources of ecologically sound and economically feasible alternatives to pesticide POPs.

- Initiate North-South as well as South-South linkages with research and private sectors partners to support development/implementation of responses to POPs.

A site tour of IITA-Bénin Station provided participants with first-hand experience of technical, material and human resources capacity required (and available) to backstop certain POP enabling activities for pesticides in Africa.

The workshop closing ceremony featured vote of thanks by the representatives of the Government of Benin and speeches by Dr. Hans Herren, Director General of ICIPE, Dr. Grace Ohayo-Mitoko, Programme Manager (POPs-Africa) of UNIDO and Dr. Braima James, Director of IITA-Benin.

2.4 PARTICIPANTS

Annex 5 lists the participants by country and institutional affiliation with full contact details. Participants were selected in consultation between UNIDO, IITA, ICIPE, and the SP-IPM Secretariat. Sixty-one participants represented 16 countries which are active on national POP enabling activities, actually or potentially with UNIDO. Two private sector participants (one from the United States of America/USA and the other from France) with a special interest in bio-rational IPM options were invited following consultation with the SP-IPM Thematic Working Group on IPM Policy Research. One indigenous private sector participant was invited from Benin in consultation with the national plant protection service in the country. All other participants were researchers from ICIPE and IITA.

3. WORKSHOP OUTPUTS

Case studies and technical presentations raised participants' awareness of key issues, emerging options and resources available to address POPs in Africa, and set the scene for plenary and small group discussion sessions and. Annex 4 summarizes the technical papers. At end of the workshop, a CD containing all workshop papers (unedited) was produced, multiplied and distributed to participants and other interested parties.

3.1 POP CONSTRAINTS AND OPPORTUNITIES IDENTIFIED IN THE SUB-SECTORS

Workshop objective #1 on analyses of the problem area concerned a) POPs that are in use in diverse environments and production/cropping systems; b) biocontrol agents, botanical and biopesticide and other alternatives that have been field-tested and can be moved from experimental to industrial/commercial level; c) existing needs that when fulfilled can contribute to the effective replacement of POPs.

The workshop reviewed status of use of POPs and of research-for-development initiatives currently under way to address the problems in major environments in specified participating countries. Overall, participants recognised the substantial knowledge base already established on alternatives to POPs, and the progress already made in demonstrating the feasibility of these alternatives in some localities. They agreed that what is now required is large-scale demonstration of proven alternatives and fine-tuning these options to local needs. Towards this end, participants identified five intervention areas critical to the search for alternatives to POPs, and specified gaps in research, development, capacity building, and policy that remain to be tackled. The intervention areas are agriculture and food, public and community health, environment and biodiversity management; construction and infrastructures, and industry.

3.1.1 Key issues in agriculture and food production

Target area	POPs in actual[3]/potential use[4]	Available and tested alternatives	Need areas to promote alternatives
a) Cereals	DDT for stem borer control on maize in Tanzania border region	Chemical options in IPM: Carbofuran (+ + +); Carbosufan (+ + +) Biological options in IPM: Botanicals e.g., neem cake (+ +); pest natural enemies such as *Cotesia*; Bt-maize (+ + + +); ash	No GMO policy so Bt-maize can't be implemented. Neem unavailable in the area & lack of awareness. Alt. chemicals unavailable Lack of public-private partnerships
b) Vegetables, horticulture	DDT – widespread use on a variety of vegetable crops in different countries	Acephate (+ +) ; Bt (+ + +) ; modern pesticide chemistries (+ + + +) ; Metatripol for thrips (= *Metarhizium*) Biological options in IPM: Predators and parasitoids (= natural enemies); botanicals such as *Hyptis suaviolens* (+ botanical); Neem (+ + botanical); Biopesticide: – DBM granulovirus, fungi	Regulatory frameworks and quality control is lacking for biopesticide implementation Metatripol is (= *Metarhizium*) not registered (but Green Muscle is registered) Toxicology data required for biopesticides Further work on quality control, commercialization of biopesticides & biocontrol agents DDT available and cheaper, and if stocks are not destroyed DDT use will continue Bt & biopesticides are expensive Lack of public-private partnerships
c) Cash/export crops (e.g. cotton, cocoa, coffee; plantains and bananas)	DTT; Endosulfan; Dieldrin against termites; Heptachlor as a soil insecticide drench	Furadan (+); Fipronil (+ + +); Neem (+ + +) *Beauveria brogniartii against soil pest;* Soil organism management and interaction	Regulatory frameworks and quality control/assurance is lacking for biopesticide implementation Chemical registration/year is also required Heptachlor more effective but growers ignorant of alternatives

[3] Comprehensive national inventories of POPs will provide a clearer picture on he scale of POP use in these thematic areas

[4] Potential use = stockpiles available without firm guarantee that they will not be used legally or illegally

3.1.2 Key issues in public and community health

Intervention area	POPs in actual/potential use	Available and tested alternatives	Need areas to promote alternatives
a) Vector control	DDT and oil containing PCB against mosquito larva (in at least 18 African Countries)	Pyrethroids, Carbamates (Spray, coil, Treated Mosquito nets etc); mosquito repellents such as Cintronella oil and lemon oil; Predators against mosquitos (e.g., Gambusia fishes) biopesticides such as Bti and Bs; Lagenidium giganteum Pyretrhroids and good sanitation practices which are replacing DDT Integrated Vector Methods (IVM) which are replacing DDT in public health With exception to fish, all the alternatives are already on shelf	Roll Back Malaria (RBM), WHO, UNICEF, Bill Gates Foundation, South-South Cooperation National Malaria Control Program etc. Develop sustainable partnership with the industry for large scale production and fast distribution of proven biopesticides e.g., Bti and Bs, in the affected localities Building capacities and awareness campaign for the use of insecticide-treated nets by MOH, NGOs etc. No guidelines to register biopesticides (e.g., in Ghana, Benin, Togo, Congo, DR Congo); guidelines available in CILSS countries Regulatory frameworks and quality control/assurance is lacking for biopesticide implementation Training of Personnel and lab equipments Low funding, weak political will Use of traditional knowledge

3.1.3 Key issues in environment and biodiversity management

Intervention area	POPs in actual/potential use	Available and tested alternatives	Need areas to promote alternatives
a) Forests	Heptachlor for termites(in CAR)	Biopesticides in Benin include *Metarhizium* and neem products	Strengthen research capacity in the search for new alternatives to POPs
	Dieldrin for gaming illegally used in CAR	Chemicals in Tanzania include carbosulfan, carbofuran and miral	Evaluate test alternatives to POPs
b) Water ways	Dieldrin being used illegally for fishing in CAR	None	Regulatory frameworks and quality control/assurance is lacking for biopesticide implementation
	Nothing on weeds		Build capacity, awareness, & end-user ownership of proven alternatives
	DDT run off from cowpea and vegetable growing areas in valleys due to illegal use in Benin- Malawi and Botswana		Strategic alliances with industry to scale out proven alternatives
c) Hazardous wastes	POPs found in underground water through leachate near dumping sites – Nigeria	Adoption of cleaner production and environmentally sound management practices	
	Obsolete stocks of aldrin, dieldrin and toxaphene in Tanzania		

3.1.4 Key issues in construction and infrastructures

Intervention area	POPs in actual/potential use	Available and tested alternatives	Need areas to promote alternatives
a) Buildings	Chlordane, heptachlor, aldrin, DDT termite control in soil and wood (see exemptions list)	Fipronil (in Southern Africa, West Africa, East Africa, e.g. MDG) Wood resistant; Soil application of pyrethroids, imidacloprid Baits: IGRs (hexaflumuron, sulfuran) Pressure-treated wood: borates, or containing chromated salts Topical liquids, dusts and foam: pyrethroids, borates, fipronil and imidacloprid Particle barriers: sand, granite, basalt, crushed glass Metal barriers: metal shields, cones and steel mesh Wood removal and replacement Avoid contact between wood and soil Seal of the cracks in foundation Rotten lime drives away ants	Evaluate Basilic oil, Neem oil as paints, Evaluate Metarhizium as coating, repellent or bait Develop and implement appropriate policy for non-chemical alternatives Build institutional capacity and provide appropriate legislation Sensitise government, end-users and other stakeholders on termite control Integrate private sector (including informal sector) participation from inception through R&D for product development Starting from pilot/demonstration aim at achieving economy through larger scale production of basilic and neem oil, and *Metarhizium* North-south and south-south cooperation Investigate efficacy of indigenous knowledge on rotten lime/identify a.i and mechanisms of action of *rotten lime)*
b) Railways	Chlordane for rail track maintenance	As above	As above

3.1.5 Key issues in industry

Intervention area	POPs in actual/potential use	Available and tested alternatives	Need areas to promote alternatives
a) Industrial chemicals: intentional production	PCBs used in capacitors, lubricants transformers, electric bulbs and cables, paints/adhesives stencils etc	No more production and usage in most of the applications mentioned. Have been replaced largely by mineral oils in transformers.	Further research to improve on mineral oils to avoid overloading and consequent blow-up. No legislations in place. Urgent need to integrate Stockholm Convention into national laws. E.g. avoid liberalization of importation of transformers. Building capacities and awareness raising programmes for the identification of PCBs. Introduction of BAT and BEP e.g. Transfer of technologies Establish alliance with developed country Parties for the production of mineral oil
b) Industrial chemicals: unintended releases/emissions	Dioxins, Furans PCBs, HCB	Cleaner production technologies, Change of raw materials and catalysts, use of non combustion methods, Proper solid waste management, generally application of BAT and BEP	Develop toolkit for PCBs and HCB Incorporate the Stockholm Convention into national policies and legislations Introduction of BAT and BEP e.g.. Transfer of technologies

3.2 STATUS OF POP ENABLING ACTIVITIES IN THE COUNTRIES

Workshop objective #2 to assess level of prior assistance on POP enabling activities concerned the status of POP enabling activities in the countries. It also concerned regulations needed to promote the development, production and wider use of the alternatives to POPs.

Since the Stockholm convention was open for signature in May 2001, the workshop noted that UNIDO has become one of the principal agencies assisting developing and transition economy countries to meet their obligations under the convention. UNIDO actions have centered on becoming parties to the convention and assisting to prepare national implementation plans (NIPs). Over 50 member states have requested UNIDO's assistance and UNIDO has, to date, won GEF approval for proposals for about 40 countries.

In Africa, UNIDO's principal priority regions, 30 countries have requested assistance and 20 of them now have active programmes on Enabling Activities that will lead to the development of NIPs. UNIDO's assistance has been directed mainly at developing and updating national chemicals management profiles, risk assessment and management decision making for priority chemicals, developing integrated national programme and skill training for the sound management of chemicals, building credible interactive databases on chemicals/productions used, disposal, etc, and the search for alternatives to banned and restricted POPs which formed the subject matter for the workshop.

3.3 CAPACITY BUILDING AND PARTNERSHIP OPPORTUNITIES

Workshop objective #3 on capacity building concerned human resource development, technical knowledge, skills and infrastructure required to facilitate local production, marketing and safe use of alternatives to POPs. It also concerned the need to identify key players and linkages required for synergy of efforts on proposed activities.

An important element of the GEF Operational Strategy has been the use of **demonstration projects** that test the local feasibility of innovative technology/techniques or reduce barriers to their more widespread utilisation through successful results. The workshop afforded UNIDO and its partners an advantage platform for developing proposals for donor funding to address the perfection and industrialization of known and emerging alternatives to banned and restricted POPs. **Capacity building** will be required both within governments, the private sector and civil society in order to provide appropriate approaches to many aspects of management of POPs especially in the search for alternative products particularly to pesticides.

The workshop discussed the need for North-South as well as South-South linkages with research and private sectors partners to support the development and implementation of lasting responses to POPs. UNIDO, IITA, Valent Biosciences (United States of America), Natural Resources Institute of the University of Greenwich (United Kingdom) in concert with interested national partners agreed to develop project concept notes as pilot cases for GEF consideration to promote partnerships on two priority issues identified by the workshop:

- To limit DDT use in public and community health
- To develop a regulatory framework for biologically based alternatives to POP pesticides.

Each of the projects falls within the GEF focal area of Persistent Organic Pollutants – OP 14. UNIDO and IITA were agreed upon as implementing and executing agencies respectively. In terms of country eligibility, proposed pilot countries would have signed and ratified the Stockholm Convention as pre-condition to participate in the projects.

4. RECOMMENDATIONS AND PROPOSED NEXT STEPS

On the basis of workshop discussions summarized in the preceding chapters, the following five cross-cutting issues were identified as barriers to the search for and promotion of alternatives to POPs in the intervention areas, and represent key areas for project development:

4.1 UP-SCALING OF PROVEN ALTERNATIVES

The workshop identified examples of biopesticides and botanicals that have excellent potential and proven results as alternatives to POPs. The lack of constructive dialogue with the industry and low market incentives continues to discourage private sector participation in local production of these alternatives to POPs in most of Africa. The participants underlined the need for constructive dialogue with the private sector to identify short-run measures that will increase and sustain access of end-users to biologically based options and which, in the longer term, will create market incentives required to initiate and sustain local production of the products and at affordable market prices. Also, sustainable partnerships between reputable private sector/industry and the research community will be critical to the need to diversify the range of technically and economically feasible alternatives to POPs.

The workshop recommends that UNIDO/IITA/SP-IPM in partnership with the countries initiate the development of reliable data on technical and economic feasibility, quality of products, and international bio-safety standards as a basis to promote private-public sector partnership for local production and/or initial delivery of biologically based alternatives in the countries and eventually increase confidence in end-users to adopt these options instead of POPs (including other hazardous pesticides). The actual and potential benefits of the proposed private-public sector partnership should be measured, amongst other criteria, in terms of the ability in use of the products to:

- *Reduce Africa's dependency on POPs and other harmful and imported pesticides.*
- *Increase effective and safe use of these biological options to assure greater personal and environmental health benefits compared to POPs.*
- *Increase end-user income.*
- *Promote sustainability of the ecosystems and production systems.*

4.2 CAPACITY BUILDING

The search for biological alternatives to POPs is rooted in scientific capacity to accurately identify and understand biodiversity (invertebrates and plants), and screen it for candidate natural agents to replace POPs. However, taxonomy impediments (training, services, products and infrastructure) in many African countries continue to undermine self reliance in the search for candidate biologically-based alternatives to POPs. The paucity of taxonomic products and services are critical to quality control and bio-safety concerns in the production of biopesticides, botanicals and invertebrate biological control agents. Related to taxonomic impediments, is the need to address poor capacity building for accredited laboratories and personnel to correctly isolate active ingredients in alternatives identified from biodiversity in the sub-regions. Similarly the capacity to formulate botanical pesticides especially to promote stability and efficacy is practically non-existent in the national programmes.

The workshop recommends that UNIDO/IITA/SP-IPM in partnership with the countries collaborate with the African sub-regional networks (known as Locally Organized and Operated Partnerships, LOOPs) of BioNET INTERNATIONAL as the bases to address the capacity building needs that underpin the search for sustainable alternatives to POPs, particularly alternatives to the 8 POP pesticides on the list of the Stockholm Convention. The sub-regional LOOPs are in West/Central Africa, East Africa, Southern Africa and Northern Africa, and each LOOP is endorsed by the respective governments. Also, the LOOPS provide a ready made framework to integrate taxonomy capacity building with capacity building to isolate active ingredients in materials that would be screened.

4.3 REGULATORY FRAMEWORK FOR ALTERNATIVES TO POPS

Inappropriate regulatory framework to facilitate registration of biopesticides and botanical pesticides is a key impediment to the development and wide scale use of these products in Africa. However, most countries have generic laws on management of synthetic chemicals not specific to pesticides. There is a need to review these existing laws to cater for biologically-based alternatives to POPs and to guide decision making by the industry on any eventual manufacture and/or marketing of biopesticide and botanical alternatives to POPs.

The workshop recommends that the UNIDO/IITA/SP-IPM in partnership with the countries develops programmes to develop sub-region regulatory frameworks in Africa for production, quality control, commercialization and safe and defective application of biopesticides, botanicals, biocontrol agents and other biologically based alternatives to POPs. The policy framework should include development of research capacity to provide and/or evaluate toxicology data required for biopesticides and botanicals.

4.4 END-USER REVERSION TO APPLICATION OF POPS

The workshop noted with grave concern the rapid increase in the number of countries wishing to revert to DDT and some of other POPs and noted the reasons provided for the reversion. In the continued absence of support to promote existing alternatives to POPs and develop new ones, reversion to POP pesticides will greatly undo the gains made by or to be made by POP enabling activities.

The workshop recommends that the UNIDO/IITA/SP-IPM in partnership with the countries establish effective mechanisms to monitor, evaluate and assess the impact of POPs as well as the progress and impact of alternatives to POPs. The continued existence and poor storage of stockpile of obsolete pesticides coupled with illegal trafficking of the POPs need to be addressed urgently in order to discourage widening of country requests to go back to the POPs.

4.5 BRINGING WORKSHOP RECOMMENDATIONS TO FRUITION

Bringing to fruition the workshop recommendations outlined above will need a consolidation of the partnership between UNIDO, IITA, SP-IPM and national collaborators initiated through the joint organisation of the Cotonou workshop.

To this end it is recommended that UNIDO designates a Senior Expert who will devote time in working with the partners on the development of bankable projects for submission to potential donors, such as the Global Environment Facility (GEF). It is also recommended that technical papers and outputs out of the workshop be compiled for publication as a benchmark volume. The Senior Expert suggested above can also be tasked with the accomplishment of this target.

5. CONCLUSION

To implement workshop recommendations, UNIDO and IITA agreed to work with selected countries to develop appropriate field projects, preferably within the framework of sub-regional inter-governmental bodies, and to identify the resources necessary to support this new collaborative effort. In this regard, UNIDO, in concert with its workshop partners drafted two project concept notes for GEF consideration and for implementation in Ghana and Benin as pilot site countries. Each of the projects falls within the GEF focal area of Persistent Organic Pollutants – OP 14. UNIDO and IITA were agreed upon as implementing and executing agencies respectively. In terms of country eligibility, Benin and Ghana each signed the Stockholm Convention in 2001, and Ghana and Benin ratified this in 2003 and 2004respectively.

5.1 PROJECT #1: BIOLOGICAL LARVICIDES AS ALTERNATIVES TO POPS

A concept note on "Use of biological larvicides as alternatives to POPs in the control of insect vectors of malaria parasites in West Africa" was developed by UNIDO, IITA, VBC, and participating national programs in Benin and Ghana. The general project objective of the project is to enhance activities that will remove the need for urban and rural populations for application of DDT and other POP pesticides in the control of insect vectors of the malaria parasite. This will be done by testing and promoting the use of commercial formulations of bacterial pathogens as key elements of integrated vector management (IVM) to include control of mosquito larvae and adults within national and community-based health programmes in demonstration projects on their use in Benin and Ghana. The project assumes the use of existing commercial formulations of the bacterial larvicides, VectoBac (B. *thuringiensis israelensis*) and VectoLex (*B. sphaericus*). At the end of three years, the project aims to complete minimally at least five (5) demonstration trials and develop local methodology for the use of microbial/biological larvicides. The results of the demonstration trials will be scaled up within the countries being served and in other African countries requesting similar assistance, leading in overall reduction in malaria morbidity and mortality. The specific objectives of the project are to

- Develop formulations of *Bt* and *Bs* biopesticides appropriate for local applications as alternatives to POP pesticides against mosquitoes in malaria control campaigns in Benin and Ghana

- Demonstrate practical larval control in multiple locations within each country
- Build local technical expertise and the pertinent government health personnel in proper and safe application methods of these biological larvicides.
- Build local infrastructure and human capacity to effectively implement national programs
- Effect transfer of technology locally with the long term aim being to initiate local production and commercialization of the biological larvicides.

Ideally project year 1 will focus on small test plots (e.g., 100 sq. meters with minimal human or animal interference), definition of parameters for evaluating preliminary results to allow for replication of field trials to fine-tune the parameters and other aspects of the work plan. Year 2 will focus on larger areas where actual demonstrations will be carried out; these will be close to human habitats, but with minimal interference to assure that the experiments can be completed. Year 3 will focus on building local expertise for the practical implementation of these programs in endemic areas under supervision of the project team.

5.2 PROJECT #2: REGULATORY FRAMEWORK FOR ALTERNATIVES TO POPS

A concept note on "Infrastructural capacity building for registration of biopesticides" was developed by UNIDO, IITA, Natural Resources Institute (NRI) of the University of Greenwich, United Kingdom, and participating national programs in Benin and Ghana. The project objectives are to extend the achievements of earlier initiatives to the coastal West African countries of Benin and Ghana formerly linked by the French-led ISYSPHYT project. The ISYSPHYT project sought to harmonize pesticide registration requirements for the countries of Benin, Cameroon, Cote d'Ivoire, Ghana and Togo. The project will collaborate with the Environmental Protection Agency of Ghana and the Plant Protection Service of the Benin Ministry of Agriculture to expand the scale of regionally harmonized regulatory frameworks for biopesticides, build national human capacity in biopesticide dossier evaluation, risk assessment and quality control, propose physical capacity building according to needs, and increase awareness of biopesticides as valid alternatives to POPs. The expected outcomes are:

- Draft biopesticide registration guidelines for Benin and Ghana, are harmonized with those of other African nations, prepared as amendments to existing pesticide registration legislation, for submission to, and approval by national legislative assemblies.

- Increased national human capacity in evaluation of biopesticide dossiers, risk evaluation and quality control procedures.

- A website dedicated to issues on biopesticide registration, risk assessment and quality control procedures as an e-learning portal and decision-support tool for the interested public, for biopesticide users, retailers and manufacturers, for students in biological sciences, policy makers and regulators.

- The project will promote dialogue between member states of the former ISYSPHYT project to encourage wider, regional adoption of draft biopesticide registration guidelines developed for Benin and Ghana.

- As a result of these expected outcomes, the project will achieve wider awareness of biopesticides as safe and effective alternatives to banned and restricted classes of synthetic pesticides.

6. ACKNOWLEDGEMENTS

The inter-institutional workshop on the search for alternatives to banned and/or restricted persistent organic pollutants (POPs), 9 – 13 February, 2004, was jointly organized and sponsored by UNIDO, IITA and the SP-IPM of the CGIAR,. The Workshop Process Steering Group comprised representatives of:

- National research-for development programme in Nigeria represented by Prof. Oladele Osibanjo (Chair, Workshop Process Steering Group)

- National research-for development programme in Ghana represented by Dr. Jonathan Allotey (Secretary, Workshop Process Steering Group)

- National research-for development programme in Malawi represented by Mr. Lyson John Kampira, Workshop (Rapporteur, Workshop Process Steering Group)

- National research-for development programme in Benin Dr. Gualbert Gbehounou

- National research-for development programme in Central Africa Republic Ms. Victoria Gaza

- UNIDO represented by Dr. Grace Ohayo-Mitoko and Prof. Chidi Ibe

- IITA and SP-IPM represented by Dr. Braima James

- ICIPE represented by Dr. Maniania Nguya

The Head of POPs Unit, UNIDO, Dr Geoffrey Mariki was actively involved in planning the Meeting. The workshop was hosted at IITA-Benin, where logistic arrangements were made by IITA staff (particular thanks go to Mrs. Basta daGloria, Ms. Hadjaratu Diawara, Mr. Cyprien Atcha, Mr. Andre Hessouh and Mr. Felix Lokonon). Workshop process facilitators were Dr. Braima James (IITA/SP-IPM) and Prof. Chidi Ibe (UNIDO, Ghana). The contributions of these organizations and individuals - and many others unnamed - who contributed to the success of this workshop, and to the development of this report is gratefully acknowledged.

Annex 1: Workshop programme

Workshop title: The Search for Alternatives to Banned/Restricted POPs

Hosting partners: United Nations Industrial Development Organization (UNIDO), the Systemwide Program on Integrated Pest Management (SP-IPM), International Institute of Tropical Agriculture (IITA), Biological Control Center for Africa (BCCA), Cotonou, Benin

Venue: International Institute of Tropical Agriculture (IITA), Biological Control Center for Africa, Benin, Cotonou

Date: 9-13 February 2004

Timeline

Day 1: Monday 9 February

Theme: Enabling activities on POPs

Session 1: Opening ceremonies

Chair: Dr. David Arodokoun, DGal, INRAB, Benin

- Welcome remarks: B. James, Directeur, IITA-Benin
- Welcome remarks: Mr Akmel Akpa, UNIDO Resident Representative for Ghana, Togo, Benin
- Enabling activities on POPs: Prof. C. Ibe, UNIDO-Ghana
- Official opening: SE Lazare Sèhouéto, Le Ministre, Ministère de l'Agriculture, de l'Elevage et de la Pêche (MAEP), Republique du Bénin

Session 2: 1030-1230

Theme: Industrial chemicals/Govts responses to POPs

Chair: Nigeria

- Industrial chemicals/overview : Prof. O. Osibanjo
- Industrial chemicals/POPs in Benin
- Industrial chemicals/POPs in Nigeria
- Industrial chemicals/POPs in Ghana
- Industrial chemicals/POPs in Chad
- Industrial chemicals/POPs in Congo
- Industrial chemicals/POPs in Malawi

Session 3: 1330-1500

Breakout groups/action planning for chemicals

Session 4: 1530 – 1700

Chair: Prof O. Osibanjo

Plenary: Breakout group recommendations

Day 2: Tuesday 10 February

Theme: Alternatives to POPs: Biological control agents

Session 5: Current practices

Chair: Dr. P. Neuenschwander, IITA

- Invertebrate biological control agents in African agriculture and the environment: M. Tamo (IITA, Benin)
- Taxonomic impediments, challenges, opportunities to biocontrol in Africa: G. Goergen (IITA)
- Industry point of view and market potential: Michel Guillon (International Biocontrol Manufacturers Association, IBMA)

Session 6: 1030-1230

Theme: Experiences with biocontrol agents

Chair: Dr. P. Neuenschwander, IITA

- The implications of the Stockholm Convention on the activities of IAPSC: Nazaire Nkouka, Scientific Secretary, AU/IAPSC
- Rearing, maintenance and delivery of invertebrate biocontrol agents in Africa: O. Ajuonu, IITA, Benin
- Mycoherbicides in weed control: Fen Beed/Adolphe Avocanh, IITA, Benin
- How well integrated is biocontrol in the national IPM programs in Africa: A. Cudjoe, PPRSD, Ghana
- Controlling termites without POPs: Nguya Maniania, ICIPE, Kenya

Session 7: 1330-1500

Breakout groups/action planning on biocontrol

Session 8: 1530 – 1700

Chair: Dr. P. Neuenschwander, IITA

Plenary: Breakout group recommendations

Day 3: Wednesday 11 February

Theme: Alternatives to POPs: Botanicals

Session 9: Current practices

Chair: Dr. Hans R. Herren, ICIPE

- Botanical alternatives to chemical pesticides in Africa, A. B. Salifu (SARI, Ghana)
- Opportunities to industrialize botanical pesticides in Africa: Ana-Milena Varela, ICIPE, Kenya
- Economics of alternatives to POPs: T. Ajayi, Petralinks Consulting, Nigeria

Session 10: 1030-1230

Theme: Experiences with botanical pesticides

Chair: Dr. Hans R. Herren, ICIPE

- Cottage industrialization of neem in Ghana: S. Asare, SARI, Tamale, Ghana
- Perspectives on the use of botanical pesticides in Benin: Léonard Afouda
- Experiences with botanical pesticides in Togo
- Experiences with botanical pesticides in Niger
- Experiences with botanical pesticides in Gabon
- Experiences with botanical pesticides in Ethiopia
- Experiences with botanical pesticides in Tanzania
- Perspectives on botanicals : Bienvenu Tollo

Session 11: 1330 – 1500

Breakout groups/action planning on botanicals

Session 12: 1530 – 1700

Chair: Dr. Hans R. Herren, ICIPE

Breakout group recommendations on botanicals

Day 4: Thursday 12 February

Theme: Biopesticide alternatives to POPs

Session 13: Current practices

Chair: Dr. Grace Ohayo-Mitoko, UNIDO

- Biopesticides in Africa: A. Cherry. NRI
- Role of biorational pesticides in IPM - A commercial perspective: Prem Warrior, Global Research & Technology Assessment, Valent BioSciences Corporation, USA
- Registration and quality assurance of biopesticides: S. Saizonou (SPV-Benin)

Session 14: 1030-1230

Theme: Experiences with biopesticides

Chair: Dr. Grace Ohayo-Mitoko, UNIDO

- Granulovirus for control of the diamondback moth: A. Cherry. IITA/NRI
- Green Muscle for control of locusts and grasshoppers: C. Kooyman (IITA, Benin)
- BB for control of banana weevils: C. Nankinga, IITA/NARO, Uganda
- Kernel Bt production factory and use of Bt and fermentation products in IPM: Nguya Maniania, ICIPE, Kenya

Session 15: 1330-1500

Breakout groups/action planning on biopesticides

Session 16: 1530 – 1700

Chair: Dr. Grace Ohayo-Mitoko, UNIDO

Plenary: Breakout group recommendations

Day 5: Friday 13 February

Concurrent action planning sessions: project framework on POP replacements and special meetings of UNIDO/GEF country projects

Session 17: Next step issues/project framework

- Industrial chemicals (Chair: O. Osibanjo)
- Invertebrate biological control agents (Chair: Dr. P. Neuenschwander IITA)
- Botanical pesticides (Chair: Dr. Grace Ohayo-Mitoko UNIDO)
- Biopesticides (Chair: Dr. Hans R. Herren, ICIPE)

Session 18: 1030 – 1230

Concurrent break out sessions continue

Session 19: 1330-1500

Concurrent break out sessions continue

Session 20: 1530 – 1700

Summary of decisions and closing

Chair: Dr. David Arodokoun, DGal, INRAB, Benin

- Industrial chemicals (O. Osibanjo)
- Invertebrate biological control agents (Dr. P. Neuenschwander IITA)
- Botanical pesticides (Dr. Hans R. Herren ICIPE)
- Biopesticides (Chair: Dr. Grace Ohayo-Mitoko UNIDO)
- Next steps for (C. Ibe UNIDO/B. James, SP-IPM)
- Vote of thanks by delegate from Benin
- Closing remarks: UNIDO/SP-IPM

Annex 2: Speeches at the opening ceremony

Welcome address by Dr. Braima James, Directeur, IITA Benin Station, and Coordinator, SP-IPM

Excellence, Monsieur le Ministre de l'Agriculture, de l'Elevage et de la Pêche

Monsieur le représentant du Ministère de l'Environnement de l'Habitat et de l'Urbanisme

Monsieur le représentant de l'Organisation des Nations Unies pour le Développement et Industrialisation (ONUDI) au Ghana, au Togo et au Bénin

Monsieur le Directeur Général de l'Institut National des Recherches Agricoles du Bénin (INRAB)

Chers collègues de l'ONUDI, de l'IITA, du secteur privé et des ONGs

Chers participants, Mesdames et Messieurs,

C'est avec un réel plaisir que j'ai l'honneur de vous accueillir à la station IITA-Bénin. Comme vous le savez, les objectifs principaux de cet atelier sont le renforcement de la capacité nationale et la compréhension entre différents partenaires sur la recherche d'alternatives des Polluants Organiques Persistants (POPs). La contribution de notre station, IITA-Bénin, est particulièrement pertinente à ce sujet.

Chacun de nous est venu ici pour apporter sa contribution à l'atteinte de ces objectifs. A IITA-Bénin, nos travaux portent sur les méthodes écologiquement durables de lutte contre les ravageurs et maladies qui compromettent la sécurité alimentaire et augmentent la pauvreté. Ces travaux soutiennent également les stratégies mises en oeuvre par les gouvernements pour le renforcement des capacités des systèmes nationaux de recherche et de vulgarisation en Afrique.

En collaboration avec nos partenaires, nous avons un bon succès dans la recherche d'alternative de pesticides nuisibles. Ce succès consiste en l'utilisation des biodiversités. Pour mieux apprécier notre contribution, vous trouverez, sans doute, le temps de visiter notre collection d'arthropodes, de micro-organismes ainsi que les élevages d'insectes utilisés en lutte biologique.

Au niveau mondial, IITA-Bénin est le secrétariat du 'Systemwide Programme on Integrated Pest Management' (SP-IPM). Le SP-IPM est un programme mondial de partenariat sur la lutte intégrée contre les ravageurs. Le SP-IPM et les besoins des activités préparatoires des POPs ont une identique origine dans l'Agenda 21 du Sommet Mondial de Rio en 1992. Ce sommet a identifié la lutte intégrée contre les ravageurs comme une importante part de

solutions aux problèmes de stratégies de développement non appropriées et destructrices d'écologie et de biodiversités. En 1996, les centres internationaux de recherche agricole ont établi le SP-IPM comme réponse à l'appel de l'Agenda 21. A travers le SP-IPM, nous utilisons diverses compétences dans le monde entier pour aborder les problèmes des ravageurs, maladies et pesticides nuisibles auxquels les paysans africains sont souvent confrontés.

Chers participants, comme vous le savez, le sommet mondial de Rio est aussi l'origine de la Convention sur la diversité biologique (CBD). C'est la signature de la CBD qui nous a embarqué dans des activités préparatoires aux POPs. En Afrique, les organismes exécutifs des Nations Unies sont chargés des activités préparatoires aux POPs. C'est dans ce contexte des opportunités mutuelles sur la recherche d'alternatives des POPs que le SP-IPM et l'Organisation des Nations Unies pour le Développement et Industrialisation (ONUDI) ont conjointement organisé cet atelier.

L'ONUDI et le SP-IPM espérons que au cours de l'atelier, entre autres, les thèmes suivant seront abordés:

1. Quels sont les POPs utilisés et pour quels environnements ?

2. Quel a été le soutien des recherches et de l'industrie aux sujet d'alternatives des POPs?

3. Quels sont les besoins de recherches et développement qui, une fois satisfaits, pourront effectivement contribuer au remplacement des POPs?

4. Quels sont les agents de lutte biologique, les biopesticides, les produits botaniques est les autres options prometteurs qui ont été testés sur le terrain et ont besoin d'être industrialisés pour le remplacement des POPs?

5. Dans le domaine politique, quelles sont les réglementations existantes et nécessaires pour un contrôle qualitatif des biopesticides et autres alternatives des POPs.

6. Quels sont les acteurs principaux et les types de liens nécessaires à la synergie sur la recherche d'alternatives des POPs?

Monsieur le Ministre, Monsieur le représentant de l'ONUDI au Ghana, au Togo et au Bénin, chers participants, cet atelier servira de base pour une meilleure collaboration entre les acteurs du monde international, gouvernemental, industriel, et des ONGs au sujet d'alternatives des POPs en Afrique.

Je nous souhaite plein succès dans la conduite de cet important atelier.

Je vous remercie, et vive la coopération internationale!

Braima James

Directeur, IITA-Benin, Cotonou, Bénin
09 février 2004

Welcome remarks By Dr. Grace Ohayo-Mitoko, Programme Manager, POPs (Africa), UNIDO, Vienna, Austria

The Representative of the Honourable Minister of Agriculture, Livestock and Fisheries
The Directeur, IITA Benin Station
Mr. Chairman
UNIDO colleagues
National Project Coordinators of UNIDO/GEF enabling activities
NGO and private sector participants
Invited guests
Ladies and gentlemen

Let me begin by thanking you all most sincerely for being able to come to this important workshop.

I would also like to thank Dr. Braima James (Directeur IITA Benin Station) and IITA for their excellent organization.

I bring you from UNIDO Headquarters, Vienna, fraternal greetings from the Director General, Programme Development and Technical Corporation Division, Mr. Abel Rwendeire. They have sent their best wishes for a successful workshop.

Allow me ladies and gentlemen, to reiterate UNIDO's commitment to our client countries, during the enabling activities/action plan phase and beyond. We are particularly committed to the search for sustainable alternatives to POPs, which will ensure reduction in use and eventual elimination of POPs.

UNIDO and SP-IPM/IITA will work very closely to achieve this goal particularly with regard to POPs pesticides.

On behalf of UNIDO Headquarters, I would like to once again welcome al of you to this workshop and I wish you very fruitful discussions and deliberations.

I thank you for your attention

Dr. Grace Ohayo-Mitoko
Programme Manager, POPs (Africa), UNIDO Headquarters

Workshop address By Mr. Akmel Akpa, UNIDO Resident Representative for Ghana, Togo and Benin

Monsieur Le ministre de l'Agriculture, de l'Elevage et de la Pêche,

Monsieur Le ministre de l'Environnement, de l'Habitat et de l'Urbanisme,

Monsieur le Directeur du Centre IPM-IITA,

Chers collègues de l'ONUDI,

Mesdames et Messieurs les Coordonnateurs et points focaux nationaux du Projet POPs de l'ONUDI,

Mesdames et Messieurs les Chercheurs de l'ensemble de l'IITA,

Honorables Invités,

Mesdames, Messieurs.

Au nom de l'Organisation des Nations Unies pour le Développement Industriel (ONUDI), j'ai l'honneur de vous souhaiter la bienvenue à cet atelier sur La recherche de solutions de rechanges efficaces aux Polluants Organiques Persistants (POPs), organisé en collaboration avec nos partenaires du groupe IPM de l'Institut International pour l'Agriculture Tropicale de Cotonou (Bénin).

Avant toute chose, permettez – moi, en ce début de nouvel an, de vous présenter mes meilleurs vœux de bonne santé, de joie, de prospérité et de réussite dans tous nos projets durant l'année 2004.

Permettez - moi aussi de formuler spécialement la bienvenue à la Chargée du Programme POPs pour l'Afrique au niveau du siège de l'ONUDI, Mme (Dr) Grâce OHAYO MITOKO, et de la féliciter pour tous les efforts qu'elle consent pour faciliter le soutien de l'ONUDI aux pays africains pour la gestion rationnelle de POPs dans le cadre de la Convention de Stockholm sur les polluants organiques persistants.

Je voudrais également saluer le Professeur Chidi IBE, Conseiller régional du Programme POPs en Afrique, pour la mise en oeuvre de projet sur le terrain.

Votre présence effective monsieur le Ministre, est la preuve manifeste du grand intérêt du gouvernement du Bénin pour le Projet POPs au Bénin, et l'expression d'une volonté politique des pays africains d'accompagner toutes les initiatives visant à renforcer leurs capacités institutionnelles, pour leur permettre de remplir leurs obligations au titre de la Convention de Stockholm.

Je profite de l'occasion pour remercier le gouvernent béninois, à travers le ministre ici présent, pour l'appui constant apporté au programme de l'ONUDI au Bénin.

En marge de cet atelier, auront lieu des réunions consultatives et d'échange des responsables nationaux du projet POPs de l'ONUDI, pour envisager collectivement l'avenir de la gestion et de l'élimination des POPs en Afrique. Ce futur, Monsieur le Ministre, portera en grande partie sur la recherche de solutions de rechange efficaces aux POPs.

Cette recherche prioritaire est le fruit de nombreux débats menés les deux dernières années aux différents ateliers nationaux de lancement du Projet POPs. C'est pourquoi cet atelier revêt, pour notre organisation, un intérêt particulier.

Compte tenu de nos avantages comparatifs et de la longue expérience de notre organisation dans le domaine des activités liées aux POPs, l'ONUDI a obtenu en mai 2001 le statut d'agence d'exécution avec des opportunités élargies pour les activités sur les POPs, et l'accès direct aux allocations du FEM qui était renforcé lors de la dernière réunion de son Conseil Exécutif à Washington en novembre 2003.

Je tiens à exprimer toute la gratitude de l'ONUDI aux gouvernements des 21 pays ici représentés pour avoir choisi notre organisation comme leur partenaire principal dans la mise en œuvre de la Convention de Stockholm.

Je voudrais vous assurer de la disponibilité et l'engagement de l'ONUDI à faciliter la collaboration, de concert avec tous les partenaires nationaux et internationaux, surtout les chercheurs de l'Institut International de l'Agriculture Tropicale, pour que ce projet sur la recherche de solutions de rechanges efficaces aux POPs connaisse une évolution positive, ceci pour le bonheur des populations du continent africain, et pourquoi pas, du monde entier.

Je ne peux terminer mon allocution sans avoir exprimé mes remerciements chaleureux au Directeur de centre IPM –IITA, Bénin, Dr Braima JAMES et son équipe pour la qualité de l'organisation de cet atelier.

Compte tenu de la qualité et la diversité des compétences ici réunies, je ne doute pas un seul instant que, de nos réflexions collectives, sortiront des propositions concrètes et constructives pour un bon aboutissement du projet.

Monsieur le ministre, Honorables Invités, c'est sur cette note d'espoir que je souhaite pleins succès à nos travaux.

Je vous remercie

Official opening By Mr. Lazare Sèhouéto, Minister, Ministry of Agriculture, Livestock and Fisheries, Government of Bénin

Monsieur le Représentant du Ministre de l'Environement, de l'Habitat et de l'Urbaisme ;

Monsieur le Représentant de l'Organisation des Nations Unies pour le Developpement Industriel (ONUDI) ;

Monsieur le Directeur de la Station International de l'Institut International d'Agriculture Tropicale au Bénin ;

Monsieur le Directeur Général de l'Institut des Recherches Agricoles du Bénin ;

Mesdames et Messieurs les Directeurs Techniques et Directeurs Généraux des Départements Ministériels ;

Eminents Chercheurs et Industriels ici présents, Mesdames et messieurs ;

C'est pour moi un réel plaisir, de procéder ce jour lundi 09 février 2004, à l'ouverture officielle de l'Atelier international sur la recherche d'alternatives aux Polluants Organiques Persistants (POPs) dont l'utilisation est interdite ou restreinte par la convention de Stockholm sur la Diversité Biologique.

Mais avant tout propos, je voudrais adresser mes vifs remerciements aux organisateurs d'avoir choisi le Bénin pour abriter les présentes assises et à tous les participants d'avoir accepté si promptement se joindre à eux pour débattre d'un sujet dont l'importance, heureusement, n'échappe à personne.

En effet, rien que pour ce qui concerne uniquement le Secteur Agricole, la question des polluants organiques Persistants reste déjà suffisamment préoccupante quant l'on sait la quantité et la qualité des produits phytosanitaires et des fertilisants déversés chaque année dans nos champs.

A cet égard, il est nécessaire de rappeler que la lutte contre les ennemis des cultures, que sont entre autres les insectes, les maladies, les rongeurs et les mauvaises herbes, est encore largement tributaire de l'utilisation des pesticides de synthèse. Or, l'histoire de l'utilisation de ces produits retrace avec éloquence, à côté de leur effet bénéfique, tout le mal qu'ils peuvent faire à l'environnement, à l'utilisateur et au consommateur.

Ainsi, les organochlorés, dont le tristement célèbre DDT (Dichloro-Diphényl-Trichloroéthane) ont très vite montré leurs limites par l'empoisonnement aigu et chronique de la chaîne alimentaire. L'on sait à cet égard, que le DDT provoque la fragilisation

L'on sait à cet égard, que le DDT provoque la fragilisation de la coquille des oeufs, menaçant du coup l'éxtinction de plusieurs espèces d'oiseaux. Il se retrouve dans le lait lorsque le bétail a été nourri avec de l'herbe traitée. Il est toxique aux abeilles.

Ce qui a justifié l'interdiction de son utilisation aux Etats- Unis d'Amérique depuis la fin des années 1960, et de beaucoup d'autres produit.

Mesdames et Messieurs

Qu'il nous souvienne, qu'en 1986 la pollution chimique due à la décharge massive de mercure et de pesticides menaça d'extinction la vie dans le Rhin, fleuve important qui irrigue plusieurs pays d'Europe.

Honorables invités ;

Il n'est point nécessaire d'en dire davantage pour susciter le discernement et la méfiance vis à vis des polluants organiques persistants.

Il est de ce fait impératif de protéger notre environnement pour notre propre survie et la survie des générations futures.

C'est d'ailleurs pourquoi la convention de Stockholm sur la diversité biologique, linterdit ou restreint, à juste titre, l'utilisation des polluants organiques persistants.

Mais, force est de constater que plusieurs pesticides interdits par la Convention, sont encore utilisés en agriculture, dans les pays en dévéloppement en général et en Afrique en particulier. Il s'agit des organochlorés dont le DDT, l'aldrine, la dieldrine, le chlordane, l'endrine, l'heptachlore, l'hexachlorobenzène, pour ne citer que ceux là, faisant partie de cette famille de pesticides dangereux que l'Organisation des Nations Unies pour l'Alimentation et l'Agriculture (FAO) a baptisés « les Douze Salopards ».

Dans ce contexte, le présent atelier intervient à point nommé pour rechercher des solutions à un problème préoccupant, qui fait partie des priorités du Gouvernement du Bénin, signataire de la convention de Stockholm sur la diversité Biologique Aussi, voudrais-je exprimer toute pour vous féliciter pour la pertinence des thèmes inscrits au programme et dont la finalité est:

- d'une part de faire le point de l'utilisation des polluants organiques persistants dans chaque pays ici représenté et en Afrique en général ;

- et d'autre part de faire le point des activités de recherche sur les alternatives aux polluants organiques persistants notamment la recherche sur les agents de lutte biologique, les bio-pesticides et les pesticides botaniques,

Il Il me paraÎt tout aussi judicieux d'avoir inscrit comme points de discussion:

- l'homologation, l'industrialisation, la comecialisation et l'utilisation a grande echelle des alternatives aux polluants organiques persistants ;

- et les grandes lignes d'un projet de remplacement des polluants organiques persistants par des methodes alternatives qui sauvegardent l'environnement.

Mesdames et messieurs,

Je n'ai point de doute au regard de la qualité des participants présent à l'atelier que vos réflexions vous permettront de formuler des recommandations pertinents et pratiques.

Le Ministère de l'agriculture , de l'Elevage et de la peche compte sur les résultats de vos travaux et souhaite que la lutte phytosanitaire prenne un virage salutaire pour l'agriculture, l'environnement , l'utilisateur et de consommateur.

C'est sur ces mots d'espoir , qu'en vous souhaitant bon séjours au Bénin, je vous déclare ouvert , ce jour lundi 09 février 2004, l'atelier international sur la recherche d'alternatives aux Polluants Organiques Persistants (POPs) don't l'utilisation est interdite ou restreinte par la Convention de Stockholm sur les Polluants Organiques Persistants (POPs)

Plein succès à vos travaux

Je vous remercie

Annex 3. Abstracts

Overview of Persistent Organic Pollutants (POPs) in Africa: Prof. Oladele Osibanjo, University of Ibadan, Nigeria

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There is international concern in recent times about the dangers to human health and the environment by a group of 12 toxic chemicals known as "Persistent Organic Pollutants" or "POPs" based on scientific and toxicological evidence.

Any strategies to control release of POPs into the environment and achieve effective risk reduction measures must identify and characterise the sources. The main categories of sources identified in the region based on the GEF/UNEP RBA PTS project : were production, imports and use of PTS/POPs pesticides, issue of stocks of and reservoirs of obsolete, discarded and banned POPs pesticides and PCBs (120,000 tons, FAO 2002 revised Estimate), industrial sources (manufacture, mining, electricity, etc) for PCBs; and open/uncontrolled burning of waste for dioxins and furans. DDT is still been used for malaria control in parts of Africa.

Big data gap exists in the region on the toxicology and levels of POPs in the environment because of general lack of research and monitoring programmes, and lack of , and/or limited analytical capability for analysing POPs and the residues. Also the capacity to manage POPs chemicals is limited with inadequate legislative framework and weak enforcement of existing regulations.

Since the risk from the continuous use of these chemicals outweighs their benefits, they have to be phased out and replaced with substitutes and/or alternatives. Low awareness about alternatives to POPs however makes farmers to continue the use of POPs pesticides due to the perception that alternatives to POPs pesticides are ineffective and expensive. Other barriers to the promotion of alternatives and /or measures for reduction are also highlighted.

In conclusion a precautionary approach among others entailing a variety of regulatory and market based approaches to reduce exposure and stimulate the development of safer

substitutes, process designs and products is desirable. Emphasis should be on public awareness, mobilization of stakeholders into action especially industry and finance sectors for access to adequate financial resources towards the commercialization of viable alternatives that will address effectively problems that exist with POPs.

Overview of POPs/Industrial Chemicals in Ghana

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Article 7 of the Stockholm Convention on Persistent Organic Pollutants (POPs) requires Parties to prepare National Implementation Plans (NIPs) and assess their countries capacity to implement the plans. A preliminary assessment of the "dirty dozen" in Ghana has been conducted. This assessment included inventories on production, distribution, use, import and export, stocks and contaminated sites, releases into the environment, assessment of POPs related human health and environmental issues of concern, assessment of monitoring, research and development capacity. A national strategy for information exchange has also been developed. Detailed information gathered on POPs pesticides and especially the three industrial POPs chemicals namely, polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/PCDFs) indicate potential contamination and adverse effect of human health and the environment. Most POPs pesticides imported into Ghana found application mainly in agriculture and public health. However data on imports is lacking. As many as 455 pre-1972 possible PCB- containing transformers and 147 pieces of 33KVA possible PCB-containing capacitors were found countrywide. Ferrous and non-ferrous metal production; power generation/heating and transport were found to be the main sources of PCDD/PCDFs in Ghana. A total of 12.96 g I-TEQ of PCDD/PCDF was emitted from known sources PCDD/PCDFs in the year 2002. Evidence of misuse of both pesticides and industrial chemicals has been documented as well.

Key words: National Implementation Plans (NIPs); polychlorinated biphenyls (PCBs); polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/PCDFs); International Toxicity Equivalence (I-TEQ) ----------

Invertebrate biological control agents in African agriculture and the environment: An overview

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This paper addresses the question whether biological control can be a viable alternative to persistent organic pesticides. Four case studies of classical biological control against invasive alien pests are presented: 1) the cassava mealybug *Phenacoccus manihoti*, a showcase example of planning and implementation of one of the most successful biological control projects at continental scale; 2) the cassava green mite *Mononychellus tanajoa*, a case where interactions between biocontrol and host plan phenology are crucial for the successful control of this pest; 3); the mango mealybug *Rastrococcus invadens* accidentally introduced from Asia; and 4) the water hyacinth *Eichhornia crassipes*, a beautiful invader from South America which is now under satisfactory control on many waterways. A cost-benefit analysis of these four projects has indicated a very high return value, even including a 10% depreciation rate per annum. The total savings of the cassava mealybug project alone are estimated to be over 20 billion US$. It is therefore concluded that classical biological control of exotic invaders is not only ecologically sustainable, but also an economically profitable. Two additional examples of biological control against two major cowpea pests are briefly presented, to illustrate the potential of this approach also for pests whose origin is unclear.

Taxonomic impediments, challenges and opportunities in biological control

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The importance of taxonomy in providing the names and characteristics of all living organisms and its fundamental relevance for all scientific work in basic and applied biology is emphasized. Adequate taxonomic capabilities have proved to be the cornerstone for the development of sustainable, biologically-based pest management options which constitute environmentally sound alternatives to the use of Persistent Organic Pollutants (POPs). The taxonomic impediment described in the Darwin declaration of 1998 as the incomplete knowledge of the world's biodiversity, the worldwide decline and shortage of trained taxonomists and the impact of these deficiencies on the ability to adequatly manage the earth's biodiversity, has reached a global dimension. This crisis is particularly acute in tropical developing countries, where much of the planet's biodiversity still occurs, but where traditionally the dearth of taxonomists is the strongest. Recognising the benefits of

biosystematics for sustainable agricultural development, biodiversity management and conservation in West Africa, IITA has strengthened its own taxonomic capabilities to become one of the most significant within the subregion. However, West African governments realize that new challenges imposed to their countries seeking to comply with the Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organisation (WTO) and to fulfil the objectives anchored in the Convention on Biological Diversity (CBD) can only be tackled in a collaborative approach at international and regional level. Linked with BioNET-INTERNATIONAL, the Global Network for Taxonomy, IITA is playing a catalytic role in fostering regional expertise through active networking with 18 West African countries. The need to demonstrate the global impact of inadequate taxonomic knowledge and thus to enhance levels of expertise, information and resources is stressed.

Biological control agents: Industry point of view and market potential

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African BCA market represents 3% of total world sales (18 million USD). Despite promising results obtained from research, development of IPM programmes with the use of BCAs will be mostly restricted to high-value and export crops. Market constraints: size of national markets, low purchase power and lack of training of farmers will be an obstacle to marketing and industrialisation of BCAs.

Aid to development of BCA market focussed on some specific targets is discussed herein.

Activités du Conseil Phytosanitaire Interafricain en rapport avec la convention de Stockholm sur les POPs

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Le Conseil Phytosanitaire Interafricain est un organisme spécialisé de l'Union Africaine chargé de la politique phytosanitaire en Afrique. Il a été créé en 1956 sous recommandation de la FAO pour couvrir la région Afrique dans le domaine de la protection des végétaux.

Parmi ses missions, la gestion des pesticides est l'une des préoccupations permanentes. En adhérant complètement à la convention de Stockholm sur les POP, le CPI a basé son action sur ses dispositions qui stipulent que : ''ayant à l'esprit la décision 19/13 C du Conseil d'administration du Programme des Nations Unies pour l'environnement, du 7 février 1997, relative à l'action internationale à mener pour protéger la santé humaine et l'environnement en adoptant des mesures visant à réduire, voire éliminer, les émissions et rejets de polluants organiques persistants et résolues à protéger la santé humaine et l'environnement contre les incidences néfastes des polluants organiques persistants''

C'est dans ce cadre que le CPI consacre ses efforts dans les activités suivantes :

- Elaboration de la Stratégie Africaine Commune pour la Protection des Végétaux
- Lutte Biologique
- Renforcement des capacities
- Harmonisation des politiques phytosanitaires
- Sécurité dans l'Application des Pesticides
- Sensibilisation et vulgarisation de l'information phytosanitaire

Toutes ces activités sont développées pour aider les pays africains à promouvoir une agriculture saine et durable, afin de combler le déficit alimentaire que connaît le continent, sans compromettre l'environnement pour des générations présentes et futures.

Un accent particulier est mis sur l'harmonisation des réglementations phytosanitaires au niveau des sous-régions. Cette approche, définie dans l'Acte constitutif de l'Union Africaine comme étant la première étape de construction d'un Etat africain se justifie par le fait que:

Le Nouveau Partenariat pour le Développement de l'Afrique (NEPAD) a choisi l'agriculture comme l'une des priorités pour le développement rapide de l'Afrique. Pour contribuer efficacement à la réalisation des objectifs du NEPAD, les politiques agricoles doivent être harmonisées. La protection des végétaux étant un maillon important dans l'agriculture, le CPI se doit d'œuvrer comme un instrument du NEPAD pour la mise en pratique de sa politique.

Rearing, maintenance and delivery of invertebrate biocontrol agents in Africa

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The capacity for rearing, maintenance and delivery of invertebrate bio-control agents at the International Institute of Tropical Agriculture (IITA) was developed during the classical biological control project against the cassava mealybug, *Phenacoccus manihoti* that started by the end of the 1970s. The knowledge gained from this project was used in other bio-control projects against other arthropod pests/aquatic weeds that followed later: the cassava green mite *Mononychellus tanajoa*, the mango mealybug *Rastrococcus invadens,* the spiralling whitefly *Aleurodicus dispersus*, cowpea thrips *Megalurothrips siostedti*, maize stem/cobborer *Sesamia calamistis*, the lager grainborer *Prostephanus truncatus*, water hyacinth *Eichhornia crassipes* and water lettuce *Pistia stratiotes*. IITA is currently maintaining several bio-control agents and least twelve have been established. For the purpose of this text, the focus will be on two insect pests, the cassava mealybug, mango mealybug and two water weeds, water hyacinth and water lettuce.

Rearing bio-control agents started with the use of the traditional cage system but as demand from cassava mealybug infested countries across Africa increased, others systems were developed. Key requirements for rearing are: ideal temperature and relative humidity, adequate lighting/aeration and good sanitation in the insectary, timely availability of healthy host plants/insects preferred by agents for reproduction.

Deliveries of agents are on requests that are accompanied by an import permit issued by a competent authority of the recipient country. Successful delivery either for rearing or immediate release ensures survival of agents to their destination and since 1981, IITA has delivered agents to at least 22 countries across Africa.

Mycoherbicides for weed control

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Agricultural weeds are causing increased crop losses in West Africa due to the intensification of land use and ever shortening fallow periods. Two of the most dominant, and difficult to control, weeds are *Imperata cylindrica* and *Striga hermonthica*. There is an urgent need to implement control options for these weeds that are not reliant on chemical herbicides that act as POPs. One such alternative is the use of mycoherbicides; weed

control products developed from indigenous fungal pathogens. Weed control is improved with a mycoherbicide compared to the naturally occuring fungal pathogen. This is because inoculum is increased and available earlier than would occur naturally. Furthermore, as a consequence of appropriate mycoherbicide formulation and application, infection rates are increased by overcoming environmental conditions that would otherwise be limiting. Mycoherbicide development is particularly appropriate for resource poor farmers who currently rely on physical removal, which is prohibitive in terms of both labour and time. Chemical herbicides are not used because of problems with availability, quality, cost, equipment and risks to human health and the environment. The durability of control provided by a mycoherbicide exceeds that of chemical herbicides as resistance takes considerably longer to develop. In addition, mycoherbicdes are weed specific and thus there are no deletereous effects to other components of the environment. The stages of development required to produce a registered and commercially available product will be discussed. As a practical example the development of a mycoherbicide to control the aquatic weed *Eichhornia crassipes* at IITA will be presented. A key factor for the development of an effective mycoherbicide is to elucidate epidemiological and ecological interactions. The importance of studies to understand interactions with the environment will be illustrated by an investigation of the effect of nutrient content in water on the efficacy of mycoherbicide control for water hyacinth.

How well integrated is biocontrol in national IPM programs in Africa

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The use of agrochemicals to increase agricultural productivity has been recognized as a major challenge to national, International and Non-Govermental Organisations (NGOs) and individual practitioners. The dangers posed by inappropriate use of pesticides dictate the need to search for alternatives to banned or restricted chemicals including Persistent Organic Pollutants (POPs). The need for human resource capacities to search for such alternatives cannot be underestimated. A review of how well integrated bicontrol is in the National IPM programs in Africa reveal that a nucleus of such human resource capacities and some local infrastructure exist, *par excellence*, in many countries where IITA and other agencies have engaged in biocontrol or IPM activities. A list of some African countries and their Institutions with such capacities to carry out research and development of biocontrol

shows how well integrated such an approach is in the National IPM programmes. However, *ipso-facto*, some capacity building may be required in such a dynamic field. Developed capacities to carry out biocontrol research and development now exist though African countries may be at different levels of integrating biological control into IPM activities due to several reasons.

Thus the search for alternatives to banned or restricted pesticides can be supported or handled by National Programmes with technical backstopping from IITA and ICIPE.

(Key words, *Biocontrol, IPM program, POPs, Capacity building)*

Management of Termites without Persistent Organic Pollutants

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Termites are known to concentrate their feeding activities on dead plant material from wood to humus. By these activities they contribute to the soil profile, soil texture and redistribution of organic matter. But in their quest for cellulose, termites may also cause significant damage to crops, trees and houses of poor subsistence farmers, particularly in developing countries. The annual economic cost of damage by termites to structural buildings in urban areas, agriculture and forestry is estimated at US$ 30 billion worldwide. The use of organochlorine pesticides such as aldrin, dieldrin, chlordane, endrin, heptachlor and mirex has been the principal approach to termite management during the last 50 years. These products, and also methyl bromide for termite fumigation have been banned. However, exemptions for three of the POPs pesticides (chlordane, heptachlor and mirex) have been requested. This implies that these pesticides will continue to be used as long as there are no alternatives. Because of dual role of termites in the environment, termites should not be indiscriminately controlled but their biodiversity should be preserved. Limited progress has been made in the development of new alternatives to POPs and concerns are increasing about adverse effects from the continued use of some of the chemical alternatives such as chlorpyrifos. Therefore, there is an urgent need to develop alternative non-chemical technologies. While some progress has been recorded for the control of termites in buildings, little progress has been made in agricultural settings. The entomopathogenic fungus *Metarhizium anisopliae* is being regarded as the most promising biological control agent for termite control. Field trials carried out in Kenya and Uganda

have shown that application of the fungus could effectively protect lawn, nursery trees and maize crops against termite attacks. A 70% increase in yield was reported on maize in Uganda. In addition, single application of the fungus to a wooden building similar to those encountered in rural dwellings in Africa has shown to protect the building from termite attack for up to 3 years. The efficacy of this fungus is still being tested in Tanzania and Ghana. On-farm participatory trials conducted in the coastal region of Kenya by the Kenya Agricultural Research Institute (KARI) in 2001 showed that the technology was acceptable by farmers and could easily be adopted. Further studies are required to demonstrate the feasibility of the technology on large-scale, establish the necessary requirements and needs for transferring the technology, and to process the registration dossier.

Opportunities to industrialize botanical pesticides in Africa

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Plant concoctions have been used since long by farmers to protect their crops in many parts of the world. These traditional methods were nearly forgotten with the introduction of synthetic pesticides. Growing awareness of toxicological and environmental problems linked to synthetic pesticides, and the restriction/banning of POPs, has led to an increasing search for alternatives. Consequently, interest in botanicals, has revived. Among those, the neem tree is one of the most promising.

Many initiatives and projects are promoting use and production of neem-based pesticides. Initially, on-farm production of simple, home-made pesticides was considered the best option for resource-poor farmers. However, this approach has shown several shortcomings. As a result, since the late 1990s emphasis has been put on the promotion of commercial neem-based pesticides. High-tech processing, based on the extraction of the main active ingredient azadirachtin, has been developed to produce high quality products. This technology is expensive and thus pursued mainly in industrialised countries. An intermediate technology to produce simple, standardised, ready for use pesticides with a reasonable shelf life is now considered as an alternative for developing countries. Such products are being produced and marketed Ghana, Kenya and Senegal.

A small-scale industry for production of ready to use neem-based pesticides in Kenya is presented as a case study. This initiative was started in 1996 at ICIPE and currently several locally produced neem-based pesticides have been registered and are sold for use in horticulture. However, their use is still limited, and there is potential for use in other crops. This is due to constraints such as lack of understanding of mode of action, high costs of products, and availability among others. Some of these aspects can be addressed by further research (in production and marketing issues) and awareness campaigns. However, this should go hand in hand with changes in unfavourable policies. For instance, inadequate registration requirements have slowed down marketing and adoption of botanicals.

Aperçu général et perspectives sur l'utilisation des pesticides botaniques au Bénin

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Des pertes importantes de rendement dues aux problèmes phytosanitaires ont contraint les agriculteurs du Bénin à un usage souvent abusif des pesticides de synthèse. Cette situation a eu pour conséquences, entre autres, le développement de résistances aux pesticides couramment utilisés, d'où la recherche de nouvelles alternatives de lutte.

Au nombre des alternatives, on peut citer les pesticides botaniques à base de neem, de papayer, etc. dont les agriculteurs témoignent de l'efficacité dans la lutte contre certains ravageurs redoutables de quelques cultures importantes comme le niébé, le chou ou le coton.

Malgré les avantages liés à l'utilisation de ces pesticides botaniques, et en dépit des efforts consentis par des programmes nationaux et internationaux pour leur promotion et leur vulgarisation, le taux d'adoption reste faible à cause de la pénibilité de leur préparation par les utilisateurs.

Pour relever ce taux d'adoption, il convient de promouvoir des structures privées capables de fournir des produits finis de qualité aux agriculteurs.

Biopesticides in Africa: Use, constraints and opportunities.

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Biopesticides comprising microbial and botanical pesticides, and pheromones are recognised as valuable pest control tools that have found application in diverse markets across the world. Significantly, while global agrochemical sales are declining, the global biopesticides market is increasing.

In Africa, while there is substantial interest in the use of biopesticides as alternatives to synthetic chemical pesticides, the use of microbial biopesticides remains experimental. A number of commercial products are available in South Africa and in Kenya, recent initiatives may lead to further products. In 2003, Africa's share of global biopesticide sales was approximately 3%, and worth no more than US$10–20 million. Botanical pesticides, such as neem leaf and seed extract, are widely but locally employed and commonly produced either by farmers themselves or by small enterprises. Wide scale adoption of biopesticides is hindered in Africa by a number of significant barriers. Research into the early stages of biopesticide development is conducted in publicly-funded institutes, such as IARCs, universities and National Crop Protection Programmes. Such institutes rarely have the required level of multidisciplinarity to develop a biopesticide from inception to market. Public-private partnerships are seen as a solution to this lack of capacity, however, in much of Africa, commercial capacity is weak.

Biopesticides, like chemical pesticides should be registered to protect consumers, users and the environment, and to assure quality control. In Africa, regulatory frameworks for biopesticide registration exist in only a minority of countries and this can act as a constraint.

Organic agriculture, high value niche markets, export crops and MRLs, resistance management and IPM represent significant opportunities for biopesticides in Africa, while low value subsistence crops, the traditional target of IARCs, are perhaps less suitable. Nevertheless, an economic imperative is important for sustained biopesticide use.

Biopesticides have repeatedly shown their efficacy in numerous experimental trials in W. Africa spanning a period of decades. Standing between these alternative solutions and the producer are a series of barriers; the role of IARCs and NARS is to work together with private sector and government to lower these barriers. Today, the particular challenges to wider implementation of biopesticides in Africa are the identification of key markets, creation of production capacity, identifying low cost production systems, and adoption of harmonised of regulatory and quality control procedures.

Biopesticides in integrated pest management - A global viewpoint

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A global overview on the current status of the biopesticide business in the context of integrated pest management is presented. The global biopesticide business is estimated at less than 1% of the total agricultural chemicals sales, with the largest segment being the Bt (*Bacillus thuringiensis*) based insecticides. The business of biopesticides is a very unique niche business and requires a high degree of expertise and specialized skill set in the product development as well as commercialization. Successful examples exist in this field with quality microbial products such as the Bt-based insecticide as DiPel, fungal-based nematicide DiTera and multiple B. subtilis-based products for plant disease control. The key technology drivers in this field include newer organisms, newer tools of biotechnology, advances in fermentation and formulations and precise application technologies to deliver the biopesticidal agent at the right place at the right time. Biopesticides can be successfully integrated into integrated pest management programs as a replacement and/or rotational tool, for management of resistance or reduction in quantity used of the chemical active ingredients. The successful utilization of a biopesticide is dependent on proper timing and dose, education/training of the user and applicators. It is also important to manage the expectations of the grower in terms of a return on investment. Biopesticides, if used properly, present an alternative to chemical active ingredients and should be an essential part of an integrated control program.

Homologation des biopesticides, assurance qualité

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Les produits phytopharmaceutiques mis sur le marché pour le traitement des cultures méritent d'être réglementés. Ainsi bon nombre de pays africains ont mis en place des outils d'appréciation et de contrôle de qualité pour sécuriser les utilisateurs et les consommateurs.

Devant les contraintes du marché à savoir : respect des limites maximales des résidus ,utilisation des produits de tout genre, besoin de manger des produits agricoles sains ,les bio pesticides constituent une alternative. Ces produits commencent à envahir nos marchés de manière irrégulière. Il urge alors de doter nos pays d'un arsenal juridico- technique

d'appréciation des dossiers lors des demandes d'homologation,arsenal qui devra tenir compte des aspects. Comme : la composition complète du produit formulé, la nature de l'agent biologique, les données de toxicologie et d'écotoxicologie, l'efficacité biologique du produit ,la fiche de données de sécurité, les informations relatives à l'étiquette et à l, la fiche technique du produit formulé.

Aussi faudra t-il élaborer un guide d'aide à la décision et renforcer les capacités des acteurs et des structures dans le domaine d'analyse desdits dossiers à présenter par les firmes de fabrication de ces bio pesticides De tels documents ne constituent pas une fin en soi. Aussi est-il recommandé d'identifier les cultures porteuses pour garantir l'utilisation effective de ces bio pesticides et assurer le contrôle après homologation pour garantir le marché de ces nouveaux produits .

Ce travail pourra se faire dans un creuset sous régional avec la participation active des divers acteurs

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Granulovirus for control of the diamondback moth in Benin and Ghana

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Baculoviruses are widely recognised as safe and effective biological insecticides for control of lepidopteran pests, and there are several commercially available products based on these micro-organisms. These insect viruses offer an attractive alternative pest control option because of their high virulence, minimal impact on non-target organisms, and their safety for use on human food crops. In West Africa, the principal lepidopteran pests attacking horticultural pests are the target of frequent applications of chemical insecticides that are associated with the familiar problems of environmental pollution, human contamination, rising costs and resistance development. Many of these lepidopteran pests are susceptible to infection by their own specific baculoviruses. Despite this, baculoviruses have been used only infrequently in West Africa, and then only on an experimental level.

The baculovirus of the diamondback moth, *Plutella xylostella*, has proven capacity to reduce field populations in other parts of the world. A DFID-financed project at IITA's

Biological Control Centre for Africa (BCCA), aimed to promote baculoviruses in W. Africa through the development of a *Plutella xylostella* baculovirus (PxGV).

Farmer field trials in Benin and Ghana demonstrated the efficacy of PxGV and created farmer demand. Nevertheless, significant barriers exist that currently hinder adoption and commercial development. Whilst the early stages of biopesticide development are often conducted in publicly funded research institutes, this sector usually lacks the skills to commercialise and market a product. The transition from a public research project to commercial venture calls for close public-private partnerships. Evidence suggests however that the commercial biopesticide sector in Africa is relatively weak. Furthermore, promotion of these more benign biological insecticides is unlikely to have sustained impact without a favourable policy environment: Few African countries yet have regulatory frameworks specific for biopesticides, for which the data requirements can be significantly different to those for synthetic chemicals.

Globally, the biopesticide market is largely driven by consumer, retailer and government pressure to reduce reliance on chemical pesticides. Broadly speaking, such pressure is relatively weak in Africa, such that for internal markets there are few durable imperatives driving the replacement of synthetic chemical pesticides with biopesticides. In export markets on the other hand, compliance with MRLs is leading to substitution of some chemical pesticides with biopesticides.

Finally, certain characteristics such as slow speed of kill, high specificity, and susceptibility to UV radiation can influence efficacy, market size and grower acceptance.

Green Muscle for control of locusts and grasshoppers

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Abstract: Locusts and grasshoppers are still mainly controlled by means of chemical insecticides. Until the 1980s, the insecticide of choice was Dieldrin, a persistent organic pollutant, but then it was banned in most locust affected countries under pressure from environmental groups. Organophosphate insecticides, like Fenitrothion, took its place, though whether these cause less environmental damage, is an open question. Other types of insecticides have since been introduced, like synthetic pyrethroids, phenylpyrazoles and insect-growth regulators (IGRs), but though these are less toxic to mammals, many still have

a negative impact on the environment due to their broad-spectrum nature. In 1998, a biopesticide, Green Muscle®, was launched for this market. Produced by Biological Control Products (BCP) in Pinetown, South Africa, this product has been developed by the collaborative research programme LUBILOSA. This is the first locust control product that has minimal impact on the environment because of its high specificity. Though the product is now on the market, it turns out that full acceptance is still some way off. One important hurdle is registration, which has not yet been achieved in the majority of affected countries. Acceptance by the locust control establishment is also still problematic, which primarily has to do with the product's slow speed of kill. Not much research is needed anymore to improve the product. Attention should now be concentrated on how best to incorporate Green Muscle into viable IPM programmes. It is not certain that a small company like BCP will manage this on its own. The experience with a similar product in Australia shows that strong institutional and government support may be necessary to make such a product succeed.

Biological control of the banana weevils in Africa with emphasis to *Beauveria bassiana*

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Biological control including microbial control and arthropod natural enemies are receiving increased attention as alternatives to chemical pesticides and as a key component of integrated pest management of the banana weevil. Potential microbial control strategies include the use of the entomopathogen *Beauveria bassiana*, endophytes and *Bacillus thuringensis*. Research on *B. bassiana* has involved isolation and characterisation, screening and pathogenicity testing, evaluation of mass production and delivery systems, and testing of different delivery systems under a range of agro-ecological conditions. Various strains of *B. bassiana* have been isolated from soil and insects hosts in Uganda, Kenya, South Africa, Cameroon. Many of these can cause 40%-100% mortality in 2 weeks. In Uganda, a number of candidate *B. bassiana* isolates have shown good growth and spore production on locally available substrates such as rice, cracked maize and maize bran. Field evaluation of possible

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delivery systems of *B. bassiana* were conducted in Uganda and Ghana and showed that application of the entomopathogenic fungi with planting material, pseudostem traps or soil around the banana plants can be used to infect banana weevils in the field and reduce damage to the plant. These studies have demonstrated that good potential exists for use of *B. bassiana* as a microbial control agent and would fit well with the broad IPM context being developed for the banana weevil. Further research is being undertaken to integrate *B. bassiana* with other banana weevil IPM options, such as use of semiochemical based traps and also developing economically viable delivery systems that will overcome the problems associated with field fungal efficacy, persistence and disease transmission. Current efforts in Uganda are also involving the use of endophytic fungi myrmicine ants. The integration of the different *Beauveria bassiana* delivery systems is highlighted as a key option for the management of the banana weevil.

Bacillus thuringiensis Production Factory at the International Centre of Insect Physiology and Ecology, Nairobi, Kenya

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Microbial insecticides based on insect pathogens such as bacteria, fungi, viruses, nematodes and protozoa are an important component in biological control efforts for insect pests of agriculture, forestry, human and animal health. Among the insect pathogens, *Bacillus thuringiensis* (*Bt*) is the most produced and applied biopesticide worldwide. *Bt* is an aerobic, motile, Gram-positive bacterium, containing spores and crystal proteins. It has been successfully used against a variety of agricultural pests, mainly lepidopteran pests and disease vectors such as mosquitoes and black flies. *Bt* formulations are produced and packaged much like chemical insecticides and have shelf-lives equivalent to them. Despite growing acceptance of the important role biopesticides have to play in IPM and IVM programmes, few microbial insecticides have ever made it to the market place. Production costs have always been considered as one of the constraints. It is in this context that ICIPE has established a biopesticide demonstration facility to produce *Bt* in Kenya. ICIPE began discussions with a Chinese partner (KERNEL of Wuhan Province) in 1997 with a view to lowering the costs of *Bt* products by producing them in Africa. In 2002, the Chinese Ministry of Science and Technology provided *Bt* production equipment valued at US$ 1

million towards the establishment of the demonstration facility at ICIPE. Two private sector entities, BridgeWorks Ag of Switzerland, Biop Ltd. of Kenya and Kernel of China, have expressed interest in scaling up commercial production of *Bt* beyond the planned three-year demonstration phase. The factory will produce *B. thuringiensis* var. *israelensis* and *B. sphaericus* as alternatives to DDT for malaria control and for which many African countries are still requesting exemption under the Stockholm Convention. Kenya is estimated to export an annual value of about US$ 200 million of fresh produce to the European Union (EU), but the industry is threatened by pests such as the diamondback moth, *Plutella xylostella,* and the African fruitworm, *Helicoverpa armigera*. Due to the tough pesticide residue regulations recently introduced by the EU, African producers are facing a serious problem in finding effective alternatives to chemical pesticides. *Bt* would be an important alternative for this industry.

Annex 4: The SP-IPM position on use of synthetic pesticides

In recognition of the international limitations on pesticides provided in projects supported by the World Bank and the United Nations Food and Agriculture Organisation;

In recognition of the socio-economic limitations of small-scale farmers, farm workers, and households to avoid exposure to pesticides or gain access to appropriate protective gear;

In recognition of the significant dangers involved in transport, storage, formulation, and application of toxic products in the agricultural sector;

In recognition of harmful productivity, environmental, and health impacts of the most toxic pesticides, and

With the goal of moving towards cleaner production systems, including integrated pest management (IPM) research and practice, the Systemwide Program on Integrated Pest Management strongly urges its partners that:

- IPM research should exclude persistent organic pollutants (POPs), Class I, and, where feasible, Class II compounds, as components towards IPM recommendations.

- POPs, Class I, and, where feasible, Class II compounds, should not be included as components of IPM strategies and programs.

- Research, development, and training should focus primarily on less-toxic or low toxic (e.g. Class U, biological organisms) methods, materials, and relevant policy within IPM programs.

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