RISK MANAGEMENT STRATEGY FOR LINDANE IN GHANA A MULTI-STAKEHOLDER DECISION-MAKING APPROACH FOR THE SOUND MANAGEMENT OF CHEMICALS IN A DEVELOPING ECONOMY

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Abstract
The highlights of a risk management strategy developed in 2002 for lindane (gamma-HCH) in Ghana has been presented based on Health Canada (2000) conceptual framework for risk management[1]. A situation analysis which was conducted as part of the strategy clearly shows that the continuous use of POPs such as lindane in Ghana[2] could be detrimental to the health of the exposed populations and the environment. The multi-stakeholder participatory approach used demonstrates an effective collaboration between scientists and decision-makers for the sound management of chemicals as envisaged under the proposed International Panel on Chemical Pollution (IPCP). A potential role of IPCP in the process of chemicals assessment and management in developing countries is proposed based on lessons drawn from the Ghanaian experience.

Introduction - Lindane as a Chemical of Concern in Ghana
Agriculture is a major economic sector of Ghana's economy and constitutes about 40% share in its Gross Domestic Productivity. Ghana until 2002 relied heavily on lindane (formulated as Gammalin 20EC) as a restricted pesticide in the cocoa industry. The European Union Advisory Committee on Pesticides directed the discontinuous use of lindane on cocoa by all cocoa producing countries by 2002. There was also enough evidence to suggest that lindane had found its way into the local food chain since most of the staples come from the cocoa growing areas, where the chemical was applied[2]. The National Committee on Cocoa Diseases and Pest Control (CODAPEC) of Ghana Cocoa Board (COCOBOD) conducted a survey in 2001 and found that only 76,546 litres out of the estimated 370,000 litres of Gammalin 20EC in Ghana were in specified locations. A number of these stocks in specified locations were posing risk to humans as well as contaminating the surrounding environments due to leaks from damaged caps of the containers and the general poor storage facilities available. The remaining quantities of litres of Gammalin 20EC, presumably in the hands of unauthorized persons, needed to be identified and transported to a central point for disposal in order to prevent their further misuse. There was therefore the need to design a strategy to address the situation. The aim of this paper is to outline the strategy which was designed for the risk management of lindane through a multi-stakeholder collaborative approach.

Methodology - The Conceptual Framework for Risk Management
The process of assessing and managing the risks associated with any chemical substance or agent can be considered inside a decision-making framework[3]. The Health Canada (2000) conceptual framework[1] (Figure 1), which was adopted for the current strategy, and the United States Commission on Risk Assessment and Risk Management, "Omenn Commission"[4] outlines a comprehensive process for organizing risk management at a country level.

The six stages of the framework are -formulating/identifying the problem (in a broad human health context); developing risk reduction goals and indicators/analyzing the risks; defining the options/identifying and evaluating actions; selecting or making risk reduction strategies/decisions; implementing strategy of actions taken; and evaluating the effectiveness of the results of actions taken. Relevant national stakeholders, mainly government (ministries, departments and agencies, COCOBOD, customs, etc), academia, industry, consumer protection groups, farmers associations, public interest groups, and non-governmental organizations, were involved in all six stages of the risk management strategy development. Step 1 of the framework is mainly a risk/hazard assessment process whilst the remaining steps constitute the risk management processes.

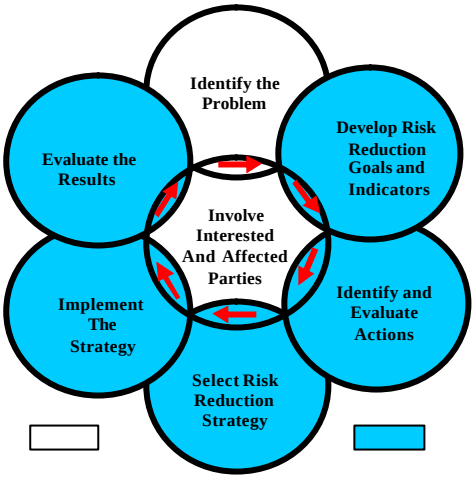

Figure 1: The Conceptual Framework for Risk Management (Adapted from Health Canada, 2000**)**

Results and Discussion

The weight of scientific evidence for adverse effects of lindane on humans and the environment gathered from several authoritative sources and the preliminary life-cycle assessment of lindane conducted[2,5,6,7] served as the risk assessment component of the study and provided the basis and justification for the risk management strategy.

Past and Present Use of Lindane

Lindane (formulated as Gammalin 20EC) has been used predominantly on cocoa in Ghana effectively against pests such as cocoa capsids or mirids. It was first experimented in Ghana in 1950 and found to be more effective than DDT. Capsids resistance to gamma-HCH was found as early as 1962. Until recently when the use on cocoa was discontinued, it was alternated with Unden (a carbamate) on cocoa. By 1978 the annual use in Ghana was about 900,000 litres per year. Though restricted for use on cocoa, due to mixed cropping, other crops (including maize, cocoyam and cassava) ended up being sprayed with lindane.

Sources, Importation, Formulation and Distribution of Lindane

Chemico Ghana Limited (formerly known as ICI Ghana Limited) formulated and distributed lindane under the product name Gammalin 20EC in 1959 with the COCOBOD as its sole client/purchaser for the cocoa industry. United Kingdom is the main source of import. Unauthorized sources may include inflow from neighboring countries.

Relevant Legislation and Current Status of Lindane

The Pesticides Control and Management Act, 1996 (Act 528) of the Ghana EPA controls the importation, distribution, use and application of lindane and classifies lindane as a restricted chemical. Lindane is currently a listed chemical under the Rotterdam Convention on Prior Informed Consent (PIC) Procedure of Certain Pesticides and Chemicals in International Trade, of which Ghana is a Party.

Human Health and Environmental Exposure/Effects of Lindane

Monitoring of health and environmental effects of lindane in Ghana is not properly documented. Anecdotal evidence exists on persons dying from acute poisoning following accidental ingestion of lindane contaminated vegetables consumed shortly after application and also from (intentional) suicidal attempts. Failure to observe safety practices partly accounts for the potential for high risk exposure. Some studies have however shown residue levels of lindane in maize grains to be 0.02 µg/g, which is below the recommended maximum residue limits. It was reported that Gammalin 20EC stocks (manufacture between 1997 and 1999) were leaking and contaminating the environment due to damaged caps and the general poor storage facilities. Recommended disposal practices are currently being developed. In the past users indiscriminately disposed of unused/obsolete stocks without due regard to human health and the environment. User and applicators including storekeepers and dealers avoid the use of personal protective equipment such as nose masks, goggles etc and were thus prone to high risks of contamination and poisoning.

Summary of the Risk Management Strategy for Lindane in Ghana:
A summary of the Strategy for lindane in Ghana is provided below in line the Health Canada 2000 model.

Risk Reduction Goals & Indicators
The Overall goal of Strategy was to discontinue the use of lindane on Cocoa by 2002, and ultimately eliminate it from use in Ghana by 2005. Selected indicators included - records of retrieved stocks and empty containers; number of trained personnel; establishment of a monitoring mechanism; storage of retrieved lindane in secured depots; public cooperation and cessation in use; cessation in cross-border movement; availability and use of safer and affordable alternatives; and reports of physical destruction or disposal of identified stocks of lindane and empty containers.

Risk Reduction Actions
Four risk reduction actions proposed were: retrieval of leftover stocks and empty containers from unauthorized hands and appropriate disposal; strengthening/coordinating activities of institutions involved in pest management/chemicals management; tightening of Customs control points; and promotion of safer and affordable alternatives.

A decision and weighing criteria were applied based on the option assessment matrix below (Table 1). Based on the ranking, the first, second and fourth risk reduction actions were selected as most attractive risk reduction measures for the strategy. To ensure an effective implementation of the risk reduction strategy the most relevant stakeholders were selected and assigned with specific responsibilities. Resource needs of stakeholders were also identified.

Table 1: Option Assessment Matrix for Evaluating Risk Management Actions for Lindane in Ghana[7]

Criteria	Action 1	Action 2	Action 3	Action 4
Effectiveness	3	3	3	3
Practicability	2	3	2	3
Monitorability	3	3	2	2
Cost/Benefit	2	2	2	2
TOTAL	**10**	**11**	**9**	**10**

Strategy Implementation
Specific actions or options were selected and prioritized for each of the selected actions discussed above using screening, ranking, aggregate and quantitative approaches. For effective implementation of the risk reduction actions, the most relevant stakeholders were identified and assigned with specific responsibilities including their legal mandates and realistic time frames. Resource needs and vulnerable groups were identified
Obtaining Commitments from Decision-Makers and Taking Action
An expert team was tasked to submit the summary of the risk management strategy (including key issues and anticipated beneficiaries) to identified decision-makers including ministries responsible for the Environment, Food and Agriculture, Health; the Parliamentary Sub-committee on Environment; and the Attorney General's Department.

Evaluating Impacts
The objective of this step was to evaluate the progress and impact of the strategy and to ascertain whether additional actions were warranted. The risk reduction sub-goals and associated indicators developed were intended to serve as the basis for the evaluation. The evaluation sought to quantify the successes or achievements of the overall goal/sub-goals of the Strategy, provide information on results of present actions as well as lessons learned in order to guide future risk management decision-making. Specifically the evaluation sought to provide a feedback to verify whether: the risk reduction actions were implemented as planned (taking into account the milestones and timeframes); assumptions made during problem identification step and its context were correct; risk reduction actions resulted in desired results; new information emerged and required strengthening and/or modifications to the Strategy.
Conclusions and Recommendations
The situation analysis clearly showed that the continuous use of lindane in Ghana could be detrimental to the health of the exposed populations (end-users, vulnerable groups, and the environment). The conceptual framework for risk

management proved to be a good starting point for a meaningful risk assessment/risk management decision making. A predictive risk assessment model to assess the impacts on exposed populations to releases of lindane and other POPs is strongly recommended. Various sources of releases may include consumption of food and meat/fish on the market, drinking water, consumption of cocoa products, vegetables etc.

Potential role of IPCP in the Process of Chemicals Assessment and Management in Developing Countries

Critical scientific information/data are required in order to carry out comprehensive assessments of consumer and occupational exposures to chemical contaminants. IPCP could serve as the best forum to promote the dialogue between scientists and policy/decision-makers as well as help cross fertilizes scientific ideas and current trends among scientists in developing countries particularly those on the continent of Africa.

Priority areas that demand short and long term urgent attention include the following: trained specialists in clinical toxicology to manage poisoning cases in health institutions and establishment of poison information centers; well-equipped national accredited laboratories with state of the art extraction and analytical techniques (ICP, GC, GC-MS, HPLC, NMR, etc) with funding mechanisms for running costs; experts with the requisite qualifications to regulate and manage chemical contaminants; establishment of scientific exchange programmes with countries with advanced know-how (e.g. running of summer schools, training of PhD students); establishment of centres of excellence equipped with geographic information systems (GIS) for data interpretation and visualization for effective risk communication; effective information and communication strategies for the sound management of chemicals. Since the establishment of well equipped laboratories in Africa will take time, in the first step some of the priority areas should be addressed by research collaborations of experienced research groups in industriaized and developing countries, which might be coordinated by IPCP.

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