

# **Integrated approaches to assess indicators of the effectiveness of pesticide management practices: Challenges and opportunities for developing countries**

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## **Background**

Agriculture is a dominant component of the global economy, and the pressure to produce enough food for the world's ever growing population has had a worldwide impact on agricultural practices and the environment. The challenge of securing a sufficient food supply was high-lighted in Agenda 21 of the United Nations Conference on Environment and Development in 1992. As a result, the use of fertilizers and pesticides has steadily increased over the years to ensure and sustain high crop yields.

One challenge for developing countries is to evaluate the impact of the application of Good Agricultural Practices (GAP), including the identification and use of environmental indicators in, for example, water and soil. Water is the primary pathway by which pesticides are transported from their site of application to groundwater, streams, rivers, lakes, reservoirs, and oceans.

The economic, social, environmental and public health implications of decreasing water quality are a worldwide threat. Surface waters not only supply a large amount of drinking water to populations, they are also vital for aquatic ecosystems that provide important environmental and economic benefits. Fresh water is predicted to become the principal limitation for sustainable development within this century.

Preventing and controlling pollution of water resources, both surface and groundwater, is a government function that has lead to the adoption of a variety of legislative approaches.

Legislation has mainly dealt with the control of "point source" pollution, i.e., pollution that can be tracked to a specific entry point, such as industrial discharges, domestic sewage or municipal wastewater effluents or treatment plants.

Reduction of "non-point source" pollution, on the other hand, can be achieved economically through the application of precautionary measures, including GAP, and through adherence to national requirements on the safe use of pesticides in the field.

## **The new role of the analytical laboratory**

The analysis made by Jill E. Hobbs in her paper on "Incentives and disincentives for the adoption of Good Agricultural practices (GAP)" highlighted that one of the disincentives for farmers to adopt GAP is the lack of an adequate institutional infrastructure. For example, one of the current GAP systems (EUREPGAP) requires evidence of residue testing through national government laboratories accredited on the basis of a laboratory quality standard, such as ISO 17025, as well as traceability requirements related to the farm on which the product was grown. It also requires that farmers can access at any time the necessary institutional infrastructure to verify the input quality, output quality and source of the agricultural commodity. According to Hobbs, poor farmers, especially those in developing countries, may not have access to these types of services.

The role of the analytical laboratory is now being perceived as a critical point that needs to be addressed to create institutional infrastructures and reference points for farmers. Quality monitoring

and certification could become a complementary activity to residue analysis currently carried out by laboratories, since certification involves the interpretation and extension of analytical results to whole lots or production batches. It is also often the case that in developing countries knowledge on the application of quality assurance systems is normally within the laboratories. The evidence provided by the laboratory of true product quality can help ensure the integrity of products according to GAP and add economic value for farmers. The analytical laboratory can also play a key role in strengthening IPM through monitoring of environmental indicators, which would lead to improved applications of GAP. With reference to fresh fruits and vegetables, animals and animal products, in some developing countries a possibility exists for establishing direct farmer support through farmer field schools (FFS), which is a technique used by the Global Integrated Pest Management (IPM) facility under the World Bank, FAO, UNDP and UNEP.

Membership of FAO is confined to nations; associate membership to territories or groups of territories. The European Union is a member as a regional economic integration organization and can vote on behalf of its Member States in certain matters.

UNEP and FAO started developing and promoting voluntary information exchange programmes in the mid-1980s. UNEP established the London Guidelines for the Exchange of Information on Chemicals in International Trade in 1987. In 1989, the UNEP and FAO jointly introduced the voluntary Prior Informed Consent (PIC) procedure, to help to ensure that governments had the necessary information to assess the risks of hazardous chemicals and to take informed decisions on their future import.

Annex III of the Rotterdam Convention lists hazardous pesticides and certain pesticide formulations, but also asbestos and industrial chemicals which are concerned under the convention.

### **Effective analytical monitoring of environmental indicators**

To monitor environmental indicators, such as pollution in water and particulates/sediments, requires quality data since one can only base management decisions on reliable and scientifically sound measurements. Effective monitoring schemes are necessary to identify specific pollutants, their sources and occurrences, to develop preventive measures, and to assess the efficacy of corrective actions. Developing countries face many problems in establishing appropriate monitoring schemes to evaluate surface/ground water pollution by pesticides, and in producing valid analytical results.

With respect to contaminants in water, the U.S. Geological Survey (USGS) stated that “there is the need for long-term monitoring studies which include a larger number of pesticides and their transformation products”. The major difficulty, as pointed out by Ongley (1994) is that “a common observation amongst water quality professionals is that many water quality programmes, especially in developing countries, collect the wrong parameters, from the wrong places, using the wrong substrates and at inappropriate sampling frequencies, and produce data that are often quite unreliable”.

### **The tools available for the laboratory**

The Commonwealth Scientific and Industrial Research Organization (CSIRO - Australia), with initial funding from IAEA, developed a “Pesticide Impact Ranking Index” (PIRI) software package to rank pesticides in terms of their relative pollution potential to soils, ground and surface water, and to compare different cropping systems in catchment areas in terms of their relative impact on water quality. The PIRI software can use generic pesticide sorption/degradation data and process pesticide-use data to provide a first tier assessment of the pollution risks to surface and groundwater. The expansion of the scope of the PIRI software will require laboratories to obtain and calibrate the PIRI risk assessments with water monitoring data. The scope of the software could be expanded if

laboratories could provide local soil-pesticide sorption/degradation parameters and water monitoring data to update the PIRI risk assessments

LabPal is a database that manages laboratory information and processing of samples. The system does not log raw information from instruments but is a powerful tool to simplify compliance with analytical quality management standards. LabPal is based on the Drupal Open Source Content Management System. Another open source tool for laboratories is the FAO/IAEA eLearning system-based on a-Tutor. A survey commissioned by the Commonwealth of Learning concluded that a-Tutor took best advantage of new LAMP open source technology (Apache, PHP, MySQL) and SCORM standards for exchange of content. Experience gained since the February 2005 launch of the eLearning system in Costa Rica confirms the value of eLearning in accelerating capacity building. The FAO/IAEA eLearning system draws on an integrated set of databases, including the FAO/IAEA International Food Contaminant and Residue Information System (INFOCRIS), which is being used by IUPAC to improve global availability of information on agrochemicals.

### **Laboratory Outputs**

Developing countries should ensure the safe use of agrochemicals to provide an adequate and safe food supply whilst ensuring environmental sustainability under the agricultural production system applied. This will require pesticide registration and post-registration monitoring to produce evidence of the application of Good Agricultural Practices, including well documented pesticide application records and access to agricultural extension services or crop manuals.

The analytical laboratory can provide first-tier pesticide impact ranking and targeted analytical monitoring as a cost-effective option for developing countries to identify specific water pollutants, their sources and occurrences.

LabPal and harmonized protocols for sampling and analysis of surface water will aid the implementation of analytical quality management. Georeferenced data, guidelines, and access to eLearning courses will accelerate capacity building and lead to three major outcomes: (1) cost-effective and sustainable catchment targeted monitoring schemes for surface water; (2) mechanisms to feed back the results of laboratory analysis to the primary producers through community/extension services; and (3) information exchange on harmonized analytical methods and water monitoring schemes to improve pesticide management practices and the production of safe food.

### **Meeting Regulatory and Market Expectations**

Knowledge on analytical quality management should be used to establish transparent and sound business plans for sustainable laboratory based monitoring schemes. Recently two options have become available to render pesticide monitoring sustainable at the laboratory level: one uses a pesticide surcharge, set in the national legislation with support from national agrochemical associations. This serves as a mechanism to obtain funding for training, IPM and pesticide monitoring. The second option deals with generating funds by charging for analytical services and adding value to products through the application of GAP. Success depends upon the involvement of rural credit officers as stakeholders in the farm-to-fork approach, and ensuring that small producers have relevant information regarding the possibilities for production according to GAP. Ideally, this could lead to a mechanism (e.g. a recognized label) to add value to the crops produced according to the GAP and sustainable development strategy. Farmers would receive economic benefits by enabling them to trade their products internationally and by adding value to their commodities. As an example of economic incentives for farmers, "Fair Trade" initiatives have been launched in a number of developing

countries and are receiving growing support from consumers. Advantages in the use of integrated approaches to assess indicators of the effectiveness of area-wide pesticide management practices, or in other words in well-maintained farm-to-market routes, include not only expanded market opportunities for cash crops but also enhanced ecotourism.