Pesticides in developing countries and the International Code of Conduct on the Distribution and the Use of Pesticides

J. Brodesser*, D.H. Byron*, A. Cannavan*, I.G. Ferris*, K. Gross-Helmert*, J. Hendrichs*, B.M. Maestroni*, J. Unsworth**, G. Vaagt*** and F. Zapata**.

*FAO/IAEA Joint Programme, **Consultant, ***FAO

Vector control for disease prevention

Following the discovery of synthetic residual insecticides in the 1940s, large-scale programmes succeeded in bringing many of the important vector-borne diseases under control. By the late 1960s, most vector-borne diseases (except malaria in Africa) were no longer considered of primary public health importance. The result was that control programmes lapsed, resources dwindled, and specialists in vector control disappeared from public health units. Within two decades, many important vector-borne diseases had re-emerged or spread to new areas. The time has come to restore vector control to its key role in the prevention of disease transmission, albeit with an increased emphasis on multiple measures, whether pesticide-based or involving environmental modification, and with a strengthened managerial and operational capacity.

The Green Revolution

The "Green Revolution" boosted yields of key cereal crops with high yielding varieties and high inputs of water, fertilizers and pesticides. The techniques introduced to the developing world by the Green Revolution include extensive use of chemical fertilizers. Previously, the enhancement of soil conditions had relied only on techniques such as crop rotation, mixing of crops, or organic fertilizers. The major development of the Green Revolution in this field was the use of chemical fertilizers to adjust the soil pH balance and achieve the right levels of all the important chemical compounds needed for the plant to grow.

Irrigation: Although it has been in use in agriculture for thousands of years, the Green Revolution further developed irrigation methods to allow for more efficient irrigation. It was possible to have more than one harvest per year with reduced dependence on monsoon/rainy seasons.

Use of heavy machinery: Mechanized harvesters and other machinery were not new to agriculture, but the Green Revolution allowed a drastic reduction in the input of human labour to agriculture by extending the use of machinery to automate every possible agricultural process.

Pesticides and herbicides: The development of chemical pesticides and herbicides (including organochlorine and organophosphate compounds) allowed further improvements in crop yields by allowing for efficient weed control and eradication of insect pests.

Pest Control

Pest control is critical to quarantine requirements and to meet market demands. Published estimates of losses for rice, wheat, maize, potatoes, cotton, soybean, barley, and coffee using FAO data for 1988-90 show that pre-harvest losses due to pathogens, animal pests, and weeds were 42%. Post harvest losses were estimated at an additional 10%. Therefore, despite all pest control procedures, half of annual global food production is lost.

Strong growth is evident in the trade of agricultural products in all regions except North America. Reduction in EU agricultural subsidies may create further opportunities for developed countries to benefit from trade liberalization. But without proper infrastructure and coordination in place to manage pesticides and other input, the rapid growth may lead to crises. Trade in food commodities can increase the spread of pests and diseases.

The initial increases in yield derived from insect pest control were dramatic, and the use of insecticides increased rapidly through the late 1940s. Usage expanded again with the Green Revolution introduction of high-yielding varieties, particularly of maize and rice, during the 1960s. Conservation farming, including no-tillage, enabled herbicides to replace the plough and thus reduce soil erosion and fuel costs.

There is very limited long-term data on the amount of pesticides used globally. US/EPA data show that the total amount of pesticide applied remained constant (or decreased) in terms of weight of active ingredients from 1979 – 97. One reason is that synthetic pyrethroids, sulphonylureas etc, have typical use rates of g ai/ha (active ingredient per hectare) whereas in the 1970s the organo-phosphates, organotins, carbamates, chlorinated hydrocarbons and triazines were applied at kg ai/ha.

Pesticide market in the U.S. and worldwide

U.S. pesticide amounts used in both 2000 and 2001 exceeded 1.2 billion pounds, in proportions similar to those of world pesticide use, with a larger portion of total pesticide use as herbicides. U.S. pesticide amounts used accounted for more than 20% of total world pesticide amounts used, more than 25% of world herbicide amounts used, less than 10% of world insecticide amounts used, and approximately 15% and 30% of world fungicides and other pesticide amounts used, respectively .

Long-term pesticide sales data are the main global & regional indicators of pesticide use. The market shares of herbicides, insecticides and fungicides have changed slightly over the last 25 years. The most noticeable trend is the reduction in the share of pesticides having high mammalian toxicity (insecticides).

Pesticide sales increased 30% between 2003-2004 in the Latin American region. Pesticide sales are projected to increase from US$ 5.4 billion in 2004 to US$ 7.5 billion by 2009. Average annual growth rate for this period is 5% per year. Many of the older, more hazardous, products account for a high proportion of sales in Latin America including 2,4-D, paraquat, methamidophos, methomyl, endosulfan and chlorpyrifos.

While globally fungicides account for 21% of sales, in Latin America they accounted for 35% of sales in 2003 (strobilurin and pyraclostrobin are major contributors). However, as product patents expire, more farmers may be using pesticides without their use necessarily being reflected in the pesticide sales figures. There is a need for Member States to contribute information to the FAO Pesticide Consumption database.

According to AGROW analysts, the following three factors contributed to this “spike”:

- Genetically Modified Organisms (GMOs)
- No tillage
- Pest outbreaks

Genetically Modified Organisms (GMOs)

In 2004 GM technology was employed by 14 countries (with small areas in a further three). The area under GM crops in 2004 was 13.3 million hectares. The US acreage is the largest, followed by

Argentina, Canada, Brazil, China, Paraguay, India, South Africa, Uruguay, Australia, Romania, Mexico, Spain and the Philippines.

In the US in 2004, herbicide-resistant varieties were expected to constitute 86% of all soybean hectares and 40% of maize. The GM seed market could grow at 8.2% a year, rising from US$ 3,656 million in 2002 to reach US$ 5,776 million in 2007. Growth is expected to remain largely in North America, which currently accounts for 74% of GM seed sales, followed by Latin America and Asia. Expansion is likely to be based largely on glyphosate-resistance and insect-resistance based on the Bacillus thuringiensis (Bt) gene. Environmentalists and industry cannot agree on whether the increasing growth in GM crops will increase pesticide use. But there is some evidence that in the short term Bt crops have reduced the use of other insecticides while an increase in herbicide use is associated with the adoption of herbicide-resistant GM crops.

No till agriculture – the herbicide connection

No tillage, or conservation tillage agricultural strategies, which reduce or eliminate ploughing, have been rapidly adopted in Latin America over the last 15 years. In terms of hectares planted, it increased 20 times in Latin America between 1987 and 1997. As a percentage of national cropland, no-tillage has continued to grow, and by 2000 it accounted for 55% of cropland in Paraguay, 45% in Argentina and 39% in Brazil. No-tillage strategies can reduce soil erosion, sediment loading, fuel use, increase carbon sequestration and pesticide residues.

Disease outbreak

An outbreak of Asian soybean rust (Phakopsora pachyrhizi) first appeared in Paraguay in 2001 and has spread rapidly. Nearly all soybean growing areas in Brazil were affected where farmers are applying possibly twice in a season, thereby increasing fungicide usage by over six-fold in 2003/2004.

Climate change

Although the impact of climate change operates over a longer time scale the potential impact is profound if the region is unprepared. Dengue, schistosomiasis, and Rift Valley fever are only three examples of major human diseases that may be influenced by global climate change. We can combat all three diseases with environmental sanitation and health education. In spite of these measures, we have not been successful in controlling them and we can expect local and world changes in temperature and rainfall to make their control more difficult.

Freeing Trade in Agriculture

The majority of people in poor countries are farmers, more than 70% of the populations of low income countries live in rural areas, and 97% of their rural populations are engaged in agriculture. Poor farmers generally earn meagre returns. Currently farmers lose about 42% of their crops to pests (weeds, diseases and insects). Without modern technologies crop losses would be nearly 70% of global production. Modern technologies improve the quantity and quality of food for consumers, and they have reduced malnutrition worldwide. Greater agricultural productivity and international trade have made this possible.

Problems of infrastructure in developing countries

Almost half of the world's workers are involved in some way in agricultural production, with the greatest concentration of these in developing countries. While developing countries account for just one third of global pesticide consumption, the vast majority of pesticide poisonings occur in these countries. Studies conducted by the International Labour Organisation (ILO) suggest that pesticide misuse causes 14% of occupational injuries in agriculture and, in some countries, as much as 10% of fatalities.

There is a lack of appropriate pesticide control legislation and lack of a modern pesticides approval/registration procedure and/or inadequate resources to implement and enforce existing schemes, lack of legislation on working conditions and lack of post-registration monitoring of pesticides. Access to acutely toxic (cheaper) pesticides is easy (fish drying, committing suicide/perpetrating terrorist attacks). Faulty equipment, poor-quality products and adulteration render products more hazardous or ineffective and contribute to over dosing.

Problems facing developing countries:

- Lack of capacity (manpower and financial resources) to advise on and enforce national laws, approved codes of conduct.
- Inadequate management and storage of obsolete stocks and used packaging materials.
- Lack of facilities for proper waste management.
- Spray equipment in poor condition, including leaks and blocked nozzles; common use of "informal" application techniques (bucket and brush).
- Lack of washing facilities to shower after spraying and for regular washing of clothes; clothes may be washed in sources of drinking water.
- Reuse of containers for food and drink storage, no facilities for safe disposal.
- Supply problems caused by: repackaging in small containers without labels and instructions; limited range of products, and; quality of pesticide products.
- Lack of baseline and trend pesticide data in food (MRL) and water (MPL).
- Lack of pesticide resistance monitoring data and resistance strategies to prevent over dosing.
- Overlapping mandates and coordination of the necessary technical resources.

Contributing factors:

- Poor information leading to a lack of knowledge about pests and pesticides hazards (scientists, analysts, extension workers, decision makers and applicators).
- Complex label instructions, labels not in local languages, poor literacy and understanding of pesticide hazards.
- Lack of information record keeping at the small enterprise level (e.g. farms) on storage, handling, use of pesticides and disposal of waste pesticides and empty containers.
- Application without protection – farmers and farm workers lack of protective clothing, even if available, climatic conditions make it impossible to wear.
- No training in application procedures or hazard awareness, leading to: mixing with bare hands; combining different products; applying on crops for which a product is not intended (cotton pesticides on vegetables, public health insecticides on dried fish).

- Houses near fields, and non-target crops and biodiversity affected by spray drift.
- Inability to recognize pests, predators and to measure economic losses, thus leading to a "pesticide treadmill" effect when no alternatives are available.
- Difficulties for scientists in developing countries to quickly update their skills and move from a reactive fighting "bush fires" to a proactive prevention focusing on GAP and problems rather than symptoms.

Impact of pesticide resistance and network for global pesticide resistance management is based on a regional structure. Growing problems with pesticide resistance:

- Insects – more than 432 species resistant.
- Weeds – 305 resistant biotypes, 182 species (109 dicots and 73 monocots).
- Fungi – 90 species resistant to 34 fungicides and bactericides (Ogawa et al., 1983).
- Lack of information on new technologies and analytical approaches.

Integrated Pest Management (IPM) Farmer Field Schools are a solution to these problems.

Code of Conduct (CoC) on the Distribution and Use of Pesticides

The CoC serves as a point of reference for sound pesticide management practices, in particular for government authorities and the pesticide industry. It addresses:

- International organizations.
- Governments of exporting and importing countries.
- The pesticide industry, the application equipment industry.
- Traders, the food industry, users.
- Public sector organizations such as environmental groups, consumer groups, and trade unions.

The CoC emphasizes the shared responsibility of the many sectors of society and, in particular, the need for co-operative efforts between governments of pesticide importing and exporting countries to promote practices that minimize potential health and environmental risks associated with pesticides while ensuring their effective use. It aims to represent an up-to-date standard for pesticide management, focusing on risk reduction, protection of human and environmental health, and support for sustainable agricultural development by using pesticides in an effective manner and applying Integrated Pest Management (IPM) strategies.

Way forward

Integrated pesticide management:

- Employing synergies between agriculture, profitability, conservation of natural resources and environmental protection.
- Applying multi-disciplinary team approaches requires a new way of working and learning together.

Addressing barriers:

- Environmental costs (correct pricing signals and exchange rates).

- Infrastructure deficiencies.
- Information deficiencies.

Knowing where and when to intervene:

- Catchment location / Environmental change / Land transformation / Critical zones / Hotspots / Flash-points / Fire points.

Why at catchment scale:

- Defines policies and regulations at national/ regional levels.
- Prevents costly national and regional disasters.
- Facilitates a "complete" water/contaminant balance, with possibility to scale up and down.
- Incorporates benefits and cost of interventions.
- Focuses scarce resources on the problems and not their symptoms.

How far have we come?

In the highly interrelated, interdependent world of modern technology and trade, the challenge of protecting crops and livestock from insects, diseases, weeds and other pests without hazards to humans, animals or their environment requires the combined and sustained efforts of scientists, technicians and administrators; producers, processors and distributors; industry and government; and of nations working together to establish and administer sound, acceptable standards of food safety and environmental quality (FAO 1985).

Where are we going?

- Markets and infrastructure are the best way to improve food security, improve consumer choice and enhance fair trade practices.
- An integrated approach to the management of land, water and external inputs, when fully developed, has the potential to value add to commodity trade and foster the adoption of GAP and agribusiness from farm-to-fork.
- Implementation requires education, capacity building and multidisciplinary teams to address barriers.
- Success depends on knowing where and when to intervene and the learning lessons identified from good and bad case studies.