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This current “User’s Manual” was produced at the same time as the ACF position on agrochemicals (November 2010). It aims to facilitate the operational roll-out of the positioning and support the field teams in setting up and implementing agricultural projects where the use of pesticides may be considered.

**INTRODUCTION**

Soaring food prices have put food security and agriculture back on the policy agenda (FAO\(^1\), 2009). Economic crises have typically resulted in declining public investment in agriculture, with devastating impacts on poverty and hunger. Past experience and empirical studies tell us that economic crises are a particularly bad time to reduce agricultural support; indeed, it should be increased. For example, distribution of agricultural inputs such as pesticides and fertilizers should be promoted, first, to protect crops, and second, to improve plant nutrition.

Progress in plant protection contributed substantially to increasing yields and improved regularity of production. The phytosanitary products of synthesis were very effective and reliable in a significant number of cases. But today the systematic use of these products is being questioned, as awareness of associated environmental and human health risks has increased.

Pesticides have helped to increase crop yields and food security. However, unlike products marketed in the developed world, many pesticides used in developing countries do not meet international quality standards.

Environmental contamination by agrochemicals is a growing concern, and, as the production and use of chemicals for agricultural activities has increased, environmental contamination has become a national and international issue. For instance, a number of pesticides have been detected in groundwater in the United States, Europe and elsewhere in the past year. Agrochemical contamination of plant food (vegetables) is also a growing concern. Such contamination may occur when farmers use agrochemicals to improve soil fertility or protect crops from pest infestation.

Many individuals and groups advocate the use of “natural” pesticides, reasoning that since they are found in nature, and are not synthetically produced, they are safer to use. While the toxicity of many natural products, such as inorganic minerals (boric acid, limestone, diatomaceous earth) and botanicals (pyrethrum, limonene, and many others) may be low, we cannot assume that this is always true. For example, strychnine and nicotine are derived from plants, and both are highly toxic. Methyl bromide and aluminium phosphide are also derived from natural products, but as fumigants they are category 1, highly toxic pesticides. Many other natural plant oils that are used for pest management have also caused serious illnesses when misused, particularly at doses higher than necessary or allowed.

As the world’s population continues to increase, the demand for food will increase as well. Some estimates suggest that to provide enough food for the expanding population, we need to produce as much food in the next 20 years as we have in the last 10,000 years. This idea has also been supported by an expert meeting on how to feed the world in 2050\(^2\).

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2 FAO. 2009. Investment requirements under new demands on world agriculture
CHAPTER I: OVERVIEW OF PESTICIDES AND KEY DEFINITIONS

1. Pesticide development (a brief history)

Pesticides are by no means a new invention. The first recorded intentional use of a pesticide dates back to 2500 BC, when the Sumerians rubbed foul-smelling sulphur compounds on their bodies, believing that the stench would repel insects and mites. Ancient Egyptians also experimented with pesticides. The Ebers’ Papyrus, the oldest known medical document (circa 1550 BC) describes over 800 recipes, many of which contain recognizable substances that were used as poisons and pesticides.

By the 15th century, toxic chemicals such as arsenic, mercury and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides: pyrethrum, which is derived from chrysanthemums, and rotenone, which is derived from the roots of tropical vegetables.

In 1934, the fungicide thiram was developed, which over the next ten years led to the development of a series of effective and widely-used fungicides. Swiss chemist Paul Müller developed a new compound in 1939 that profoundly changed the lives of farmers and people around the world when he discovered the insecticidal properties of DDT (dichlorodiphenyltrichloroethane). Müller demonstrated that DDT killed the Colorado potato beetle, a pest that was ravaging potato crops across North America and Europe. His innovation later earned him the Nobel Prize, and DDT became the most widely used pesticide in the world.

In the 1940s manufacturers began to produce large amounts of synthetic pesticides, and their use became widespread. Some sources consider the 1940s and 1950s to have been the start of the pesticide era.

2. Pests

A pest is any harmful, noxious, or troublesome organism. Pests include weeds, insects, fungi, bacteria, viruses, rodents, or other plants or animals.

3. What is a pesticide?

FAO\(^3\) has defined a pesticide as: Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals that cause harm during, or otherwise interfere with, the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as plant growth regulators, defoliants, desiccants or agents for thinning fruit or preventing the premature falling of fruit, and substances applied to crops either before or after harvest to protect a commodity from deterioration during storage and transport.

Pesticides are products that control or manage pests. Many pesticides kill their targets. However, controlling pests does not always involve killing them. Some pesticides simply repel the pests from the site where they are causing a problem.

Though often misunderstood as referring only to insecticides, the term “pesticide” also applies to herbicides, fungicides, and other substances that are used to control pests.

4. Pesticide groupings
There are many types of pest control products, which have been developed for a wide range of situations. They are grouped in three ways:
- by the types of pests they control
- by the way they work (their mode of action)
- by their chemical families

4.1 Target pests
Pesticides are most commonly grouped by the types of pests they control. Common types of pesticides and their targets include:

Table #1 Types of pesticides and target pests

<table>
<thead>
<tr>
<th>Type of pesticide</th>
<th>Target pest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungicides</td>
<td>Fungi</td>
</tr>
<tr>
<td>Herbicides (e.g. glyphosate)</td>
<td>Plants (weeds)</td>
</tr>
<tr>
<td>Insecticides (e.g. organochlorines, organophosphates, carbamates, and pyrethroides)</td>
<td>Insects</td>
</tr>
<tr>
<td>Nematicides</td>
<td>Nematodes (microscopic worms)</td>
</tr>
<tr>
<td>Avicides</td>
<td>Birds</td>
</tr>
<tr>
<td>Rodenticides</td>
<td>Rodents</td>
</tr>
<tr>
<td>Acaricides</td>
<td>Spiders, mites</td>
</tr>
<tr>
<td>Algaeicides</td>
<td>Algae</td>
</tr>
<tr>
<td>Bactericides</td>
<td>Bacteria</td>
</tr>
<tr>
<td>Miticides</td>
<td>Mites</td>
</tr>
<tr>
<td>Molluscides</td>
<td>Snails, slugs</td>
</tr>
<tr>
<td>Piscicides</td>
<td>Fish</td>
</tr>
<tr>
<td>Virucides</td>
<td>Virus (e.g. H5N1)</td>
</tr>
</tbody>
</table>

Pesticides can also be classed as synthetic pesticides or biological pesticides (biopesticides), although the distinction can sometimes blur.

Broad-spectrum pesticides can kill an array of species, while narrow-spectrum, or selective pesticides only kill a small group of species.

A systemic pesticide is absorbed by a plant and then moves inside it. Insecticides and most fungicides usually move upward (through the xylem) and outward.

Such movement may result in increased efficiency. Systemic insecticide that poisons pollen and nectar in a plant’s flowers may kill pollinators such as bees. Most pesticides work by poisoning pests.
In 2009, the development of a few classes of fungicides called paldoxins was announced. These fungicides take advantage of chemicals, called phytoalexins, that plants release as a defense mechanism, and are believed to be safer and greener.

### 4.2 Mode of action

The “mode of action” indicates how a pesticide works to stop the pest from functioning normally, and eventually suppress or even kill it.

Many pesticides fall into more than one mode of action group. Pesticides grouped by their mode of action include (see table below):

#### Table #2 Types of pesticides and mode of action

<table>
<thead>
<tr>
<th>Type of pesticide</th>
<th>Mode of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact pesticides</td>
<td>Control pests through direct contact.</td>
</tr>
<tr>
<td>Systemic pesticides</td>
<td>Applied to the leaves or roots of plants, and are absorbed and move (are translocated) throughout the plant to wherever they can interrupt a pest's normal functioning.</td>
</tr>
<tr>
<td>Stomach ingestion</td>
<td>Control insects that eat the pesticide-treated crop</td>
</tr>
<tr>
<td>Fumigants</td>
<td>Work as a gas that controls pests that breathe it in.</td>
</tr>
<tr>
<td>Attractants</td>
<td>Attract insects to a trap with a smell or scent.</td>
</tr>
<tr>
<td>Protectant pesticides</td>
<td>Often fungicides that provide a protective covering for the plant that forms a barrier between the pest and the plant before the disease can infect it.</td>
</tr>
<tr>
<td>Eradicant pesticides</td>
<td>Kill a pest once it has infected a plant, but before it is well established.</td>
</tr>
<tr>
<td>Growth regulators</td>
<td>Are ingested by the pest and act like its own hormones to disrupt its normal development, causing it to die before it grows and reproduces.</td>
</tr>
<tr>
<td>Repellents</td>
<td>Produce an odor that repels insects.</td>
</tr>
</tbody>
</table>

### 4.3 Chemical family

A chemical family is a group of pesticides that have similar chemical makeups. Pesticides in the same chemical family often have similar modes of action, cause similar poisoning symptoms, and persist in the environment for the same amount of time. Knowledge of chemical families helps farmers to:
- select the proper pesticide;
- decide on the personal protective equipment needed
- identify necessary precautions that should be taken when handling each product;

Common pesticide chemical families include:
- chlorinated hydrocarbons
- organophosphates
- carbamates

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\(^4\) EurekAlert. (2009). New green pesticides are first to exploit plant defenses in battle of the fungi
There are many types of pesticides. The most common classifications include:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Common names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecticides (carbamates)</td>
<td>Aldicarb, carbaryl, carbofuran, methomyl, and perimicard</td>
</tr>
<tr>
<td>Herbicides (thiocarbamates)</td>
<td>Triallate, EPTAC, and butylate</td>
</tr>
<tr>
<td>Fungicides (dithiocarbamates)</td>
<td>Maneb, mancozeb, metiram, and thiram</td>
</tr>
</tbody>
</table>

Understanding how pesticides work, which pests they control, and which chemical family they belong to can help you choose the most appropriate product. It can also help you better protect human health and the environment.

For example, glyphosate is the common name of an herbicide. Roundup and Touchdown are two trade names for glyphosate. Carbaryl is the common name for a well-known insecticide, and its trade name is Sevin.

<table>
<thead>
<tr>
<th>Pesticide type</th>
<th>Common name</th>
<th>Trade name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dicamba</td>
<td>Banvel</td>
<td></td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Roundup</td>
<td></td>
</tr>
<tr>
<td>Metribuzin</td>
<td>Sencor</td>
<td></td>
</tr>
<tr>
<td>Trifluralin</td>
<td>Treflan, bonanza</td>
<td></td>
</tr>
<tr>
<td>2,4-D+Dicamba+Mecoprop</td>
<td>Killex, kill-mor</td>
<td></td>
</tr>
<tr>
<td>Fungicides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>Bravo 500</td>
<td></td>
</tr>
<tr>
<td>Mancozeb</td>
<td>Dithane, Manzate</td>
<td></td>
</tr>
<tr>
<td>Insecticides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metalaxyl</td>
<td>RidomilGold</td>
<td></td>
</tr>
<tr>
<td>Endosulfan</td>
<td>Thiodan, Endosulfan</td>
<td></td>
</tr>
<tr>
<td>Azimphos-methyl</td>
<td>Sniper, Guthion</td>
<td></td>
</tr>
<tr>
<td>Cypermethrin</td>
<td>Ripecord, Cymbush</td>
<td></td>
</tr>
<tr>
<td>Carbaryl</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Etc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER II. PESTICIDES AND CONCERNS

1. Why should we be concerned about pesticides?

1.1 Human health effects

Pesticides can be dangerous to consumers, or to workers and close bystanders during their manufacture and transport, or during and after their use.

The World Health Organization (WHO) and the UN Environment Programme estimate that each year, 3 million agricultural workers in the developing world experience severe poisoning from pesticides, and about 18,000 of them die.

The use of organophosphate pesticides, which cause less environmental damage and are less persistent than organochlorine pesticides, has increased. However, workers who handle the chemicals may experience acute health problems, such as abdominal pain, dizziness, headaches, nausea, vomiting, and skin and eye problems. Many studies have also indicated that pesticide exposure is associated with long-term health problems such as respiratory problems, memory disorders, dermatologic conditions, cancer, depression, neurological deficits, miscarriages, and birth defects. Peer-reviewed research has examined links between pesticide exposure and neurological outcomes and cancer, which are, perhaps, the two most significant health problems that can afflict workers exposed to organophosphates.

Pesticide-related human health hazards are not equitably distributed around the world. Latin American farm workers are 135 times more likely to suffer pesticide poisoning than US farm workers, as they often handle unlabeled substances while wearing little or no protective equipment. Through the mid-1980’s, half of global pesticide poisonings and more than 80% of all pesticide-related deaths occurred in developing countries, while these countries account for only about 20% of pesticide use.

Pesticides differ in their toxicity as well as their persistence in the environment. The ones of most concern are those that are:

- most toxic to the widest variety of organisms, as they have the most potential to damage organisms they do not target, and
- most persistent in the environment, as they have more time to do harm.

1.2 Effects on erosion, soil structure and fertility

Herbicides can reduce vegetative ground cover, promoting soil erosion through wind and runoff. Agricultural runoff of sediment (along with associated fertilizers or pesticides) is a major problem in many surface waters, contributing to eutrophication and contamination of drinking water. When soil is lost, it takes nutrients with it, so increased erosion increases the need for fertilizer.

Decreased organic matter and increased runoff and erosion, coupled with pesticides’ effects on soil organisms, can degrade soil structure and adversely affect soil aeration, nutrient status, and water holding capacity, or water percolation.

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1.3 Effects on water quality

Pesticides also enter water, either from the air or through runoff or percolation to groundwater, where they can have harmful effects on human health and disrupt aquatic ecosystems. Effects may include diversity loss, disruption of stabilizing species interactions, disruption of food chains, and so forth. Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water, bottom sediment and food. Pesticide drift occurs when pesticide particles suspended in the air are carried by the wind to other areas, potentially contaminating them. Pesticides are a cause of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination.

2. Harmful effects of some pesticide families

2.1 Fungicides

Fungicides' toxicity to humans is generally considered to be low, but they can irritate the skin and eyes. Inhalation of spray mist or dust from these pesticides may cause throat irritation, sneezing, and coughing. Chronic exposure to low concentrations of fungicides can cause adverse health effects. Most cases of human fungicide poisoning have resulted from consumption of seed grain. To prevent such poisoning, fungicide treatments are now combined with a brightly coloured dye that clearly indicates that the seed has been treated.

2.2 Herbicides

In general, herbicides' toxicity to humans is low, since plant physiology is so different from humans. However, there are exceptions; since many herbicides are strong acids, amines, esters, and phenols, they can irritate the skin. Inhalation of spray mist may also cause coughing and a burning sensation in the nasal passages and chest. Prolonged inhalation sometimes causes dizziness. Ingestion will usually cause vomiting, a burning sensation in the stomach, diarrhoea, and muscle twitching.

2.3 Insecticides

The most serious pesticide poisonings usually result from exposure to organophosphate and carbamate insecticides. Organophosphate insecticides include chlorpyrifos, diazinon, dimenthoate, disulfoton, malathion, methyl parathion, and ethyl parathion. Carbamate compounds include carbaryl, carbofuran, methomyl, and oxamyl. Organophosphates and carbamates inhibit the enzyme cholinesterase and disrupt the nervous system. All life forms with cholinesterase in their nervous systems, such as insects, fish, birds, humans, and other mammals, can be poisoned by these chemicals.

3. Pesticide safety

Safety measures are critical for anyone working with pesticides. Any time you handle a pesticide, including choosing, buying, storing, moving, mixing, loading, applying, cleaning up, or disposing of pesticides, you must always be safety conscious.

Pesticides can poison people and livestock. They can also harm the environment. Safe pesticide use will minimize risks for the the person applying it, as well as other people, animals, and the environment.

General safety guidelines: Appropriate safety measures can help to protect people and the environment. People applying pesticides should:
-know common safety practices;
-select and handle pesticides safely;
-keep detailed application and storage records.

4. Symptoms of pesticide poisoning

The symptoms of pesticide poisoning can range from mild skin irritation to coma, or even death. Different classes or families of chemicals cause different symptoms. Individuals also vary in their sensitivity to different levels of these chemicals; some people may have no reaction to an exposure that causes severe illness in others. Because of potential health concerns, pesticide users and handlers must be able to recognize the common signs and symptoms of pesticide poisoning.

The effects, or symptoms, of pesticide poisoning can be broadly defined as either topical or systemic. Topical effects generally develop at the site of pesticide contact and result either from the pesticide’s irritant properties (either the active and/or inert ingredient) or the victim’s allergic response.

Systemic effects are quite different from topical effects. They often occur in a different area from the original point of contact, after the pesticide has been absorbed into and distributed throughout the body.

5. Pesticide labels and risks

The label is the best source of information on any pesticide product. It is also a legal document. It is against the law to use a pesticide in any way other than that stated on the label. The label is often fastened to the pesticide container. It can also be a small booklet or pamphlet packaged with or on the container. If any part of the label cannot be read, the vendor should be contacted at once for a replacement.

The pesticide label is the best source of product information. Before buying a pesticide, always read the label to confirm that the product is appropriate for your pest control needs. The pesticide label provides detailed application instructions and personal safety guidelines, as well as advice on preventing contamination of non-target plants or animals, or of the environment. Always read and follow label directions. Remember, the label is a legal document.

Pesticide risk: There is a risk of exposure any time a pesticide is handled. You should know how to measure, assess, and reduce risk. Problems that can result from pesticide use include:

- contamination of water, soil, or food
- harm to non-target plants
- poisoning of people or animals
- harm to fish, birds, bees, or other animals
- failure to control the target pest
- damage to the crop
CHAPTER III: QUESTIONS ON PESTICIDES & AGRICULTURAL PROGRAMMES

1. Introduction

Plant pests, diseases and weeds pose a serious threat to crop production. The ACF FSL technical department is concerned about finding ways to control and manage pests and diseases in a sustainable way.

What is an agricultural programme within an ACF intervention?

The overall objective of an ACF agricultural programme is to help populations provide for their own food needs, either through self-production or exchange. Programmes generally target rural areas although if land is available they can also be implemented in urban and semi-urban contexts.

Specific objectives of agricultural programmes may include:

- Agricultural rehabilitation;
- Optimizing production infrastructures;
- Promotion of dietary diversity.

Why implement agricultural programmes at ACF?

Agricultural security is one of ACF’s main objectives. We work to save lives, ease human suffering, and restore food security by working on different levels while helping to maintain people’s dignity and protect them. Agricultural programmes fit into the overall goal of food security programmes at ACF, which is “to survive today, but to also live tomorrow”. ACF Agricultural programmes target rural contexts, poor farmers with limited means of production, the most food vulnerable households, and populations that have been affected by crisis.

Ideally programme activities will allow families to achieve a level of food security equivalent to what they had before the crisis. However, this is not always possible. Where relevant, ACF tries to ensure that activities are viable over the long term.

Although projects led by ACF are often designed for the short term, they should still have a positive impact over the long term.

What type of agricultural program should be implemented? The ACF FSL technical department tries to promote sustainable agriculture.

Sustainable agriculture refers to both economic and ecological sustainability. Any truly sustainable farming system must be so in both senses; a farmer cannot stay in the farming business if his operation is not economically viable, regardless of how good it may be ecologically! While there is considerable debate about exactly what constitutes sustainable agriculture, in general it is defined in terms of practices that allow for quality of life and agricultural production for this generation, as well as future generations. Sustainable agriculture doesn't necessarily mean "organic" farming (farming without synthetic chemical inputs), although increased attention is paid to "organic components," particularly regarding fertility and pest control.
Sustainable (or alternative) agricultural practices are a more ecologically based approach to raising food, rooted in an understanding of, and respect for, ecological principles. In such systems, growers work with the ecology of the system, rather than against it.

Guiding principles for agricultural programmes within ACF:

Plans for any agricultural programme should follow several guiding principles. They include:
Do no Harm;
Integrate programmes with a longer-term perspective;
Respect programmes continuity;
Coordinate and collaborate: Internal coordination with other technical teams, as well as external communication with other humanitarian agencies or institutions, should always be promoted. Despite the additional time and effort required, all programmes should collaborate with existing local structures (such as agricultural institutes, etc.) and favour participatory approaches to the identification and establishment of activities. This will help “extension” workers to learn which agrochemical products are banned or restricted in the country or region of intervention.

Pests and diseases are one of the principle constraints on agricultural programmes. Information on specificity of agricultural seasons, programme cycles, types of diseases in the area, the agricultural calendar, pest and disease control methods, etc. should be collected onsite as soon as possible.

Examples of pesticides used by ACF agricultural programmes

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of pesticide</th>
<th>Family of pesticide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burma</td>
<td>Neem</td>
<td>Insecticide</td>
</tr>
<tr>
<td>Philippines</td>
<td>Karape</td>
<td>Insecticide</td>
</tr>
<tr>
<td>Mali</td>
<td>K-Otrhine</td>
<td>Insecticide</td>
</tr>
<tr>
<td></td>
<td>Decis ULV</td>
<td>Insecticide</td>
</tr>
<tr>
<td>Mongolia</td>
<td>Decis</td>
<td>Insecticide</td>
</tr>
<tr>
<td>Chad</td>
<td>Decis</td>
<td>Insecticide</td>
</tr>
<tr>
<td></td>
<td>Dimex</td>
<td>Insecticide</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Roundup (glyphosate)</td>
<td>Herbicide</td>
</tr>
<tr>
<td></td>
<td>Touch down DMA6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paratop</td>
<td></td>
</tr>
</tbody>
</table>

2. Why are pesticides sometimes important?

Pesticides control insect pests and diseases that affect food and fiber crops, and can improve the quantity and quality of harvested products. Some are used to control parasites on farm animals and pets. Others help maintain our health, including disinfectants that are used to clean kitchens and bathrooms. Repellents can also ward off ticks that carry disease.

3. Are pesticides necessary?

Pesticides can be necessary, but not in every situation. Many times, non-chemical control methods may be preferable; other times, it may be possible to use alternative methods to

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prevent pest damage. It is best to know and understand all available options in a given situation in order to reduce pesticide use.

4. Why are farm chemicals used in conventional agriculture?
Farm chemicals enable us to produce enough high quality, wholesome food to meet the needs of a growing population. They also allow efficient and economical pest control, and often there is no alternative control option when pests aggressively attacking crops and cause severe damage.

People who enjoy a healthy lifestyle and unrestricted access to abundant, good, inexpensive food easily forget that historically, starvation has been a major health hazard. Civilizations have been combating weeds, insects, diseases and other pests throughout history and there are many examples of their major impacts on humans. One of the worst examples is the fourteenth century’s Black Plague in Europe, when millions died from a bacterial disease spread by fleas on rats (Hock et al. 1991). Another example is the infamous Irish potato famine of the nineteenth century, in which millions died and many more were forced to emigrate from the country. Economically advanced countries have plenty of good wholesome food because they use a scientific approach to agriculture that includes the use of pesticides.

Without farm chemicals, production and quality of food would be severely jeopardised, and it is estimated that food supplies would immediately decline. However, this does not mean that ACF supports the systematic use of agrochemicals; we are simply recognising that these products made a contribution to farmers’ ability to feed the world after World War II. Nowadays, we need to change production methods’ effects on the environment.

4.1 Is there any advantage to using pesticides, and how should they be used?
Pesticides are used to control organisms that are considered harmful. For example, they can kill mosquitoes that transmit potentially deadly diseases like West Nile virus, yellow fever, and malaria. They can also kill bees, wasps or ants that can cause allergic reactions. Insecticides can protect animals from illnesses caused by parasites such as fleas. Pesticides can also prevent human sickness caused by mouldy food or diseased produce. Herbicides can kill invasive weeds that can cause environmental damage. Pesticides are used in food storage facilities to manage rodents and insects that infest food such as grain. There is risk every time pesticides are used, but proper use can decrease these risks to a level deemed acceptable by regulatory agencies.

Pesticides can save farmers money by preventing crop losses caused by insects and other pests. One study found that not using pesticides reduced crop yields by about 10%.

Pesticides are an ecological problem, and therefore control strategies must be ecologically sound. There are two approaches to pest control: prevention and cure or removal of the cause.

ACF believes that organic agriculture is most likely to benefit the poor living in marginal areas, by improving productivity and incomes while promoting environmental sustainability.

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4.2 Preventing problems
Farm chemicals are frequently used to stop pest problems from occurring. For example, they can prevent weeds from growing in gardens and lawns, treat produce for export or import to prevent pests from spreading; and treat stored products to prevent pests from attacking and destroying them during storage.

4.3 Protecting the environment
If no farm chemicals were available to control environmental pests like noxious weeds, feral animals, etc., our environment would suffer very badly.

5. What is the balance between the risks and benefits of pesticides?
By their very nature, most pesticides create some risk of harm to humans, animals, or the environment because their purpose is to kill or otherwise adversely affect living organisms.

At the same time, pesticides are useful to society. They kill organisms that cause disease and control insects, weeds, and other pests.

6. Are some pesticides safer than others?
Biologically-based pesticides such as pheromones and microbial pesticides are becoming increasingly popular and are often safer than traditional chemical pesticides.
CHAPTER IV. ALTERNATIVES TO PESTICIDES

Alternatives to pesticides are available. They include alternative methods of cultivation, use of biological controls, such as pheromones and microbial pesticides, genetic engineering, and methods of interfering with insect breeding. These methods are becoming increasingly popular and are often safer than traditional chemical pesticides. What method should be used? The section below provides information on some of the alternatives.

1. Integrated Pest Management (IPM)

The concept of IPM was introduced in the late 1960s and 1970’s. Although the term was introduced by R.F. Smith and R. van den Bosch in 1967, IPM was not really a new concept. It was commonly practiced in the years before synthetic organic insecticides became widely available. But the old ways were largely abandoned after World War II because chemical control was so effective, convenient, and inexpensive. Once the dangers of over-dependence on a single control strategy were recognized, the principles of integrated pest management gained renewed acceptance.

Under IPM, the farmer strives to manage the insect pest population instead of attempting to completely eradicate it. IPM aims to keep pests at economically insignificant levels through crop production methods that discourage pests, encourage the growth of beneficial predators or parasites that attack pests, and pesticide applications timed to coincide with the most susceptible period of the pest’s life cycle. However, IPM entails more effort because it requires an understanding of ecological principles and a thorough knowledge of pests’ life cycles and population dynamics.

The FAO Code of Conduct defines integrated pest management (IPM) as “the careful integration of a number of available pest control techniques that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce/minimise risks to human health and the environment. IPM emphasises the growth of a healthy crop with the least possible disruption of agro-ecosystems, thereby encouraging natural pest control mechanisms”.

Essentially, IPM is a system of pest control that uses a suite of biological, chemical, cultural, and temporal methods at the same time and in an environmentally sound and sustainable manner.

IPM is an alternative to modern agricultural systems’ extreme reliance on synthetic pesticides. It includes an alternative philosophy regarding pest control as well as alternative control practices.

The philosophy of IPM is that the grower does not seek to eliminate pests, but to reduce their populations to tolerable levels in order to protect the environment.

IPM uses a mixture of techniques to control pests.

IPM relies highly on natural and cultural pest control methods, and often includes some use of chemicals, as part of a balanced program.

IPM employs:
-environmental control methods (biotic and abiotic, including altered cultural practices)
-chemical controls (introduction or favouring of natural control agents, such as organisms that prey on pests)
-reproductive controls (manipulations that render pests sterile, for example)
-genetic controls (host plant resistance as well as more exotic methods, some of which involve genetic engineering)

Cultivation practices include polyculture (growing multiple types of plants), crop rotation, and planting crops in areas where the pests that damage them do not live. Planting is done at times when pests will be least problematic, and trap crops that attract pests away from the real crop are also used.

Another alternative is to release organisms that fight pests, such as natural predators or parasites of the pests. There are also biological pesticides made of entomopathogenic fungi, bacteria and viruses that cause disease in pest species.

Thermal treatment of soil through steam is another alternative to pesticides. Soil steaming kills pests and improves soil health.

2. Pest Control in Natural Systems

Plants have been coexisting with pests for millennia, and very few have gone extinct because of them. The majority of plants and pests have cohabited for a long time. What factors control pests’ impact on natural systems?

Natural pest controls include:
-genetic resistance (most plants are genetically resistant to most pests)
-natural diseases
-natural predators
-adverse weather
-host availability

3. Pesticides’ interaction with natural controls

Do pesticides interfere with these natural controls? Let’s look at whether and how each of those natural controls is affected by pesticide use.

-Genetic resistance of plants to insects and diseases is probably not directly affected by pesticides. However, pesticides remove pressure for plants to evolve resistance to insects and diseases. The knowledge that pesticide controls exist also may somewhat decrease pressure on plant breeders to breed for pest resistance, as they know that growers can rely on pesticides.

-Pesticides can have direct effects on the predators, competitors, and diseases that naturally work to control pest outbreaks. For example, ladybugs that eat aphids in a garden may be sensitive to a pesticide used to control the aphids.

-Pesticides can also have indirect effects on predators of pests, since their food supply (that is, the pests) declines when the pests are killed by pesticides. In this case, the population of the predators will decline as well, and it will be unable to control the pest when the pesticide treatment terminates.
Host availability: most simply, epidemics in nature subside when pests eat or kill so much of the host population that they essentially starve themselves (or can no longer find homes). (In fact, few epidemics in nature reach this point, as other natural control agents are usually effective then. However, in the final analysis, host availability issues will stop an epidemic if all else fails.) Use of pesticides keeps this from happening; under protection from pesticides, hosts are kept alive so surviving pests have a steady supply of food. (Of course, we’re not suggesting that a farmer can afford to let a crop be eliminated to starve the pest!)
CHAPTER V. ACF POSITION ON PESTICIDES

ACF is aware that pesticides are important in modern farming and will remain indispensable for the foreseeable future. Without them, it would be practically impossible to produce the enormous quantities of food required to feed the world’s growing population.

However, there is growing concern about the safety and quality of food. Pesticides include many hazardous substances. They must be applied with utmost care in the most efficient manner possible to protect crops and farm animals, while leaving the lowest possible residues in food and the environment.

Therefore, the ACF FSL technical department recommends:

1. ACF will promote and encourage mechanical weed control measures over the use of herbicides.
2. ACF will refrain from using any pesticides (insecticides or fungicides) until a pest has been properly identified.
3. ACF will systematically incorporate good agricultural practices into its agricultural programmes in order to prevent pest damage and reduce the use of pesticides (insecticide and fungicide). (More details on GAP can be found in Annex #1: Checklist of good gardening practices.)
4. If pest control is determined to be necessary, ACF will find the least toxic but most effective way to deal with the problem. (Information about a variety of IPM methods for controlling intolerable pests is available in Annex #2: Pest management strategies.)
5. ACF will support local traditional initiatives (such as natural biopesticides) defined and adopted by farmers to control pests and diseases.
6. ACF resort to pesticide only when crops suffer severe pest attacks and there is no alternative control option, and when good agricultural practices have been implemented without success.
7. ACF will limit the exposure of all its extension workers to pesticides and will put in place mitigation measures and consider safer alternatives such as Integrated Pest Management (IPM).

The advantages and benefits of farm chemicals should be maximized while potential problems are minimised. This can be achieved in three ways:
- by ensuring that there are adequate safeguards for the manufacture, sale and use of these products;
- by ensuring that farm chemicals are used only within integrated pest management;
- by ensuring farm chemicals are used correctly, safely and accurately by well-trained and competent applicators.


NB. The mode of action of many synthetic pesticides is similar to natural pesticides. Toxicity to people and pests can vary in natural as well as synthetic pesticides. It should not be
assumed that because a pesticide is “natural”, it is not toxic; some natural pesticides can be quite toxic. Always read the product label and follow recommended precautions.

It must be remembered that pesticides are just one choice of many effective pest management strategies. Before any pesticide or control measure is used, the checklist of good gardening practices should be consulted. If these practices are adopted first, the need for pesticides can be greatly reduced, or even eliminated.

7. All extension workers should limit exposure to pesticides and use safer alternatives. (Adopt balanced, coherent, and realistic approaches to protecting plant, animal and environmental resources; maintain a constant field monitoring system.)

The success of farming and agricultural programs depends in part on proper management of crop pests. The most responsible approach to pest control is an Integrated Pest Management (IPM) program. IPM uses a number of pest control measures. The choice between them depends on the type of pest to be controlled. Pests can often be controlled through good crop management practices, such as:
- planting pest-resistant or tolerant crops;
- using mechanical control measures, such as trapping insects and moving for weed control;
- practicing crop rotation;
- practicing intercropping;
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EurekAlert. (2009). New green pesticides are first to exploit plant defences in battle of the fungi.


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USEFUL LINKS

http://nature.berkeley.edu/~agroeco3/applying_agroecological_concepts.html
http://www.wpro.who.int/hse/pages/library.html
http://www.egfar.org/egfar/website/opensite/account/details/update
http://www.wpro.who.int/hse/pages/abstract6.html
ANNEXES ON PESTICIDES

Annex #1. Checklist of good gardening practices:

- Create healthy soil. This important step is often overlooked in the rush to plant, even though it can make the difference between a productive and a “so-so” garden. Many insects are attracted to unhealthy, poorly growing plants, which also recover more slowly from the injuries these insects cause.
- Choose pest-resistant or -tolerant plant varieties. Nursery and garden catalogues often contain information on these characteristics.
- Start with healthy, high-quality seeds and plants. Purchase stocky seeds.
- Eliminate the competition; remove weeds and grass from the growing site. They compete with plants for nutrients and water.
- Keep the plants growing vigorously. Rapidly-growing fruits and vegetables tolerate or outgrow damage from insects and diseases more easily. However, they also use up available nutrients more quickly.
- Keep things clean. After harvesting, remove plants and debris that can harbor insects and diseases. Remove weeds that may provide shelter for pests.
- Rotate crops. Planting the same crop in the same place year after year encourages the development of diseases in the soil and overwintering pests that can cause crop loss.
- Choose a sunny location that is not near large trees. Proper growth, flowering, and fruiting of most vegetable and fruit crops requires eight to ten hours of direct sunlight per day. Sunlight also helps to dry foliage and reduce the risk of many fungal and bacterial diseases.
- Water properly. Plants suffering from excessive or inadequate watering will be less vigorous and more susceptible to diseases and pests.
- Use mulch. It helps control weeds and reduces evaporation of moisture from the soil.
- Provide good air circulation. Overcrowded plants do not grow well and may have too much foliage.
- Plant at the proper time. Seeds that are planted too early are more susceptible to rot.
- Become familiar with the major pests in your area. Learn about weaknesses in their life cycles, their habits, and at which stages they are most easily controlled.
- Grow crops that are less susceptible to pests. Vegetables with low susceptibility to insects or diseases include garlic, parsley, sweet potatoes, okra, beets, snap peas, carrots, onions etc.
- Put up birdfeeders and birdhouses. Birds are the leading predators of insects.
- Inspect the entire garden at least once a week. Check for problems on the undersides of leaves and on bark.
- Have realistic expectations. Don’t expect picture-perfect produce every time. Accept the fact that there may be some crop damage and even occasional crop failure.
Annex #2. Pest management strategies:

The first step in pest management is to identify the pest that is causing the problem. You must then learn about the pest’s life cycle and behaviour in order to develop a management plan. The goal might be eradication or merely the reduction or suppression of damage.

Integrated Pest Management, or IPM, is a strategy that incorporates some or all methods available for managing a given pest. The goal should be to reduce the pest population and the damage it causes to levels that are economically and aesthetically tolerable.

Judicious selection of pest control methods should address personal and environmental safety concerns by reducing or eliminating pesticide use whenever possible. The following methods should be considered in the development of a pest management strategy:

- Mechanical exclusion: Barriers and devices such as fences, traps, lights, row covers and noisemakers can keep pests away from garden plants.
- Cultural control: Most plants and animals resist pests best when they are in good health. Therefore, keeping a potential host healthy can help prevent pest-related damage.
- Plant selection: It is important to select crop species and cultivars that are recommended for the area under cultivation. Neighbours and professionals in the community should be consulted to determine which kinds of plants grow best and do not have significant pest problems. Avoid those that have a questionable history.
- Planting dates: Most crops have recommended planting intervals, and it is wise to follow these recommendations. Careful selection of planting dates enhances crops’ defences against disease and insect infestation.
- Crop rotation: If space permits, crops should be rotated to different areas of the garden each year to stop pests from building up in the soil.
- Sanitation: Sanitation is perhaps the most important cultural pest management practice. This includes the removal of plants or plant parts suspected of harbouring insects or disease. For example, affected leaves and branches of dogwoods infected with anthracnose should be removed and destroyed so that the disease does not spread. By the same token, dead or diseased limbs should be removed from trees and shrubs.
- Biological control: This method harnesses a particular pest’s natural pathogens, predators, or parasites.
- Chemical control: Chemicals have been used for hundreds of years to control pests.

Alternative pesticides and control methods: Below is a list of some alternative pest control methods, along with their advantages and disadvantages.

- Botanical insecticides: rotenone, pyrethrum, neem.
  Advantages: Rapid breakdown, rapid action, low toxicity to mammals and plants.
  Disadvantages: Rapid breakdown requires more precise timing and/or more frequent application; cost and availability.

- Microbial insecticides: bacillus thuringensis (dipel, Thuricide, attack).
  Advantages: Selective, not toxic to wildlife or humans, may establish and provide control in the future.
  Disadvantages: Controls only one specific species or group of insects, broken down by the elements so timing is critical, special storage or application procedures may be necessary.
-Insecticidal soaps: Safer’s insecticidal soap.
Advantages: Rapid breakdown, rapid action, low toxicity to mammals and other animals, low toxicity to most plants, selective, doesn’t harm most beneficial insects.
Disadvantages: Because it breaks down rapidly, effective only against insects that come into direct contact with the spray before it dries.

-Attractants: pheromones, lures.
Advantages: Non-hazardous to humans or other animals, no residues, targets specific insects while leaving beneficial insects unharmed.
Disadvantages: Results vary depending on the weather, physical conditions, etc. Effectiveness limited to very specific adult insect populations, expensive. More useful for monitoring the presence of insects than for control purposes in most cases.

-Fungicides: sulphur, copper, bordeaux mixture.
Advantages: Provides fungicidal action and disease control.
Disadvantages: Toxic to mammals, wildlife, and many beneficials. Timing of application is critical.

-Traps: tanglefoot, sticky yellow or white boards.
Advantages: No residues, not toxic to mammals, wildlife, or beneficials.
Disadvantages: Can trap beneficial as well as pests, some traps are expensive, must be maintained, cleaned, and recoated periodically, effectiveness varies.
Annex #3. Pesticide selection:

There are a variety of pesticides registered for control of farm pests. You should try to choose the right pesticide for an Integrated Pest Management (IPM) program and control of a given pest.

The choice of pesticide for a given situation requires consideration of a number of factors. These include:
- Pest(s) to be controlled (target pest);
- Product registration;
- Beneficial organisms;
- Safety and risk of exposure for the person applying the pesticide;
- Application equipment needed;
- Personal protective equipment needed;
- Crop health and growth stage;
- Product compatibility with other pesticides;
- Work schedule;
- Pest resistance;
- Environmental factors.
Annex #4. Correct use of pesticides

Pesticides should never constitute the sole method of pest control. Misuse, overuse and abuse may lead to many of the problems previously discussed. Pesticides must be incorporated into a planned, systematic pest management program that utilizes as many control techniques as applicable. This is called Integrated Pest Management (IPM). Biological, physical, cultural, environmental and mechanical control techniques are just as important as pesticides. ACF believes that the correct approach is to use all the techniques used by organic farmers, but to supplement them with pesticide use. In other words, pesticides should be used as part of an organic farming system. The IPM philosophy and approach is, in ACF’s opinion, the only way to practice economically and ecologically sustainable farming. When pesticides are used, it is vital that they be used correctly. Considerations include:

- Selection of product;
- Compatibility with other control methods, safe world practices, label directions, timing of application, accurate application to the target, selection, adjustment and calibration of equipment, application under favourable weather conditions.