Integrated Pest Management

Pests, diseases and weeds (in short: pests) can cause yield reductions, which makes pest control indispensable part of agricultural production. Integrated Pest Management (IPM) is a sustainable approach to pest, disease and weed management involving environmentally-friendly crop production methods that reduce the use of chemical pesticides (insecticides, fungicides, herbicides).

In Afghanistan poor plant production practices exacerbate pest-related problems. This leads to poor plant growth and renders crops more vulnerable to pest attacks. IPM is effective not just at controlling pests, diseases and weeds, but also at improving the growth and productivity of crops in a sustainable manner. To apply IPM successfully, farmers must have a broad understanding of the entire production system (IPM-AF, 2014).

Principles of IPM

The FAO defines IPM as "the careful consideration of all available pest control measures that discourage the development of pests and keep the use of pesticides to levels that are **economically** justified and reduce or minimise the risks to human health and the environment" (FAO, 2014).

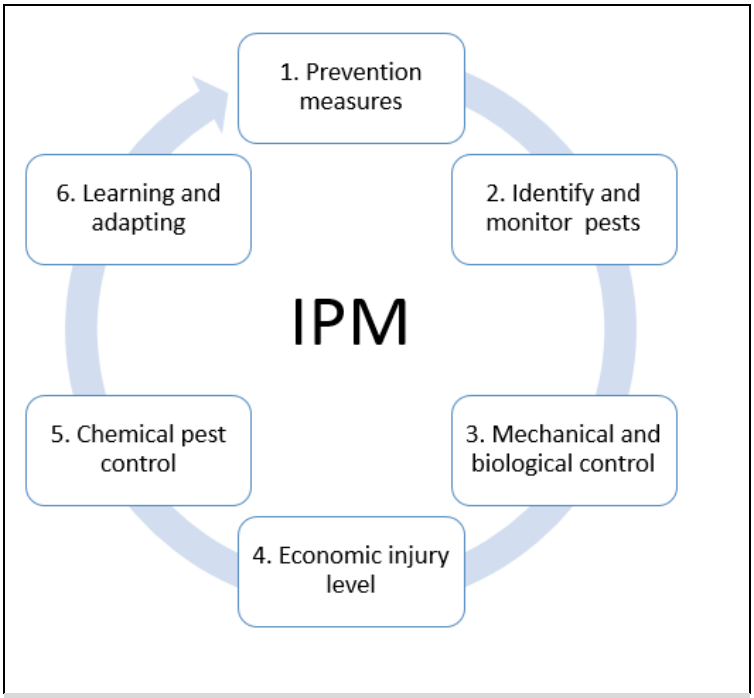


Figure 1: Steps in IPM (Helvetas Swiss Intercooperation, 2014)

IPM is an ecosystem approach that does not seek to eradicate pests but rather to manage them. IPM is a knowledge-intensive approach and requires a broad understanding of the crops, pests, natural enemies and weeds. The IPM process usually follows the steps mentioned below and presented in Figure 1 (FAO, 2014 and World Bank, 2011):

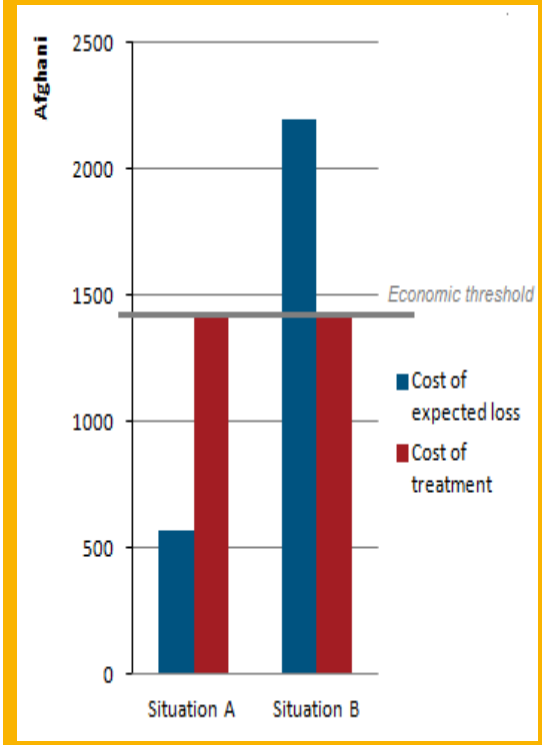
1. Prevention measures
Suppress and prevent pests from becoming a threat by establishing a healthy and balanced ecosystem through a wide range of **cultural methods**. Prevention measures can be very effective for many pests, and they will not become a nuisance.

2. Identify and monitor pests
Identify occurring pests and monitor them with adequate methods and tools (e.g. traps for insects). A comprehensive understanding of pest cycles is a prerequisite for observing pest occurrence in the field and then taking appropriate measures.

3. Mechanical and biological control
Apply mechanical and biological pest control when necessary (based on the results of monitoring). Biological and mechanical pest control can be effective for controlling pest populations. These methods are often labour-intensive, however; can contribute to keep pests below the economic injury level.

4. Economic injury level
When the pest population exceeds the economic injury level (the point at which the cash loss of the reduction in yields exceeds the cost of chemical pest control) it becomes **economically** profitable to apply pesticides (see Box 1).

Box 1: Economic injury level



Why would anyone spend 1425 Afs for pesticides to control pests that will cause yield reduction of only 570 Afs?

The economic injury level is the point at which the cost of pesticides pays off. The economic injury level is calculated for each pest in advance and expressed as a **biological threshold**, usually the number of insects/area or plant.

Situation A: The treatment costs are higher than the expected loss due to reduced yields. Pest control is not profitable.

Situation B: The expected loss from reduced yields is higher than the cost of pest control. Pesticide use pays off.

5. Chemical pest control
If all other measures have no effect, chemical pest control - mainly the use of pesticides (insecticides, herbicides, fungicides) - comes into action, but only if the economic threshold is likely to be exceeded. Chemical pest control requires the farmers to pay special attention to safety precautions so as to avoid health hazards, and environmental contamination.

6. Learning and adapting
Monitor the success of the applied measures and share your knowledge on best IPM practices with other farmers.

IPM has been shown to be successful for various crops and in many countries. However, the following drawbacks exist:

1) Knowledge-intensive approach: training in pest identification, monitoring and control is required and best organised through **Farmer Field Schools**;

2) Labour-intensive and therefore time-consuming approach;

3) There is often a lack of access to, and availability of, certain means (trap crop seeds, natural enemies, products to prepare bio-pesticides etc.).

IPM for pests

Pests – this time in a more specific sense - include all types of animal pests, and in particular insects. These include, among many others, caterpillars or weevils that make holes or feed on leaves; aphids that suck plant sap, causing curled leaves; and larva and fruit flies that often cause damaged or rotten fruits. There are many more animals - namely mites, nematodes, mammals and birds - that can all cause severe crop reductions. All of these pests play an important role in the ecosystem and should therefore not be eradicated, but managed to avoid their becoming a nuisance for agricultural production. Preventive measures are key to establishing a healthy and balanced ecosystem (USDA & UC Davis, 2013 and FiBL, 2011):

1. Prevention measures: Proper soil, water and crop management (to enhance plant health and preventing the introduction and spreading of pests); crop rotation (reduces the development of high pest populations); intercropping (to distract pests or to attract natural enemies); field sanitation (remove and destroy pest hosts); timing of sowing and harvesting (avoid crop and pest co-occurrence); trap crops (attract the pest); and measures to attract beneficial insects.

- **Neem** (*Azadirachta indica*): against many insect pests and as neem cake against nematodes
- **Pyrethrum** (*Chrysanthemum cinerarifolium*): against most insects and mites
- **Fish bean** (*Tephrosia vogelii*): against caterpillars, mites
- **Chili** (*Capsicum frutescens*): against many insect pests
- **Tobacco** (*Nicotiana spp.*): against all insects and mites (very toxic for humans)
- **Mexican and African marigold** (*Tagetes spp.*): repellent effects against insect pests, effects agains nematodes
- **Garlic** (*Allium sativum*): anti-feedant for insect pests
- **Wild basil** (*Ocimum suave*): repellent effect on insects

Figure 2: Biological preparations used for pest control (FiBL, 2011)

2. Identify and monitor pests

3. Mechanical and biological control: Collect and destroy insects manually, through soil preparation practices or using insect traps (pheromone, bait, light and colour). Apply bio-pesticides and natural preparations to reduce the pest (see Figure 2).

IPM for diseases

Diseases are caused by fungi, bacteria or viruses. Fungi cause the vast majority of diseases and are responsible for most cases of spotting, cankering, blighting, wilting, scabbing and rotting on different plant parts. Bacteria result in the breakdown of the cell wall and thus rotting; viruses generally cause leaves or other green parts to change colour. Disease management is crucial and involves the following measures (USDA & UC Davis, 2013 and FiBL, 2011):

Box 2: Resistant or tolerant varieties

Resistant: Ability of a variety to **restrict** the damage of a pest through various plant mechanisms.

Tolerant: Ability of a variety to **withstand** the damage of a pest.

Susceptible: Inability of a variety to restrict the damage of a pest

1. Prevention measures: Proper soil, water and crop management to enhance plant health and prevent the introduction and spread of diseases; crop rotation (avoid soil-borne diseases); seed treatment (to avoid seed-borne diseases); resistant crop varieties (see Box 2); field sanitation (remove and burn infected plants); timing of sowing and harvesting (avoid crop and disease co-occurrence).

2. Identify and monitor diseases

3. Mechanical and biological control: Burning of infested plants; apply bio-pesticides and natural preparations to reduce diseases.

IPM for weeds

A weed is any plant that is undesirable or troublesome in the field because it reduces crop yields and quality through competition for nutrients, light and water, or in some cases through an allelopathic effect. Moreover, weeds can be hosts for insects and diseases aggravating their effects. On the other hand, weeds also provide cover for the soil and reduce erosion as well as provide a habitat for beneficial organisms (USDA & UC Davis, 2013 and FiBL, 2011):

1. Prevention measures: Limit the introduction, development and multiplication of weeds through: crop rotation and intercropping (suppresses weeds); crop variety selection (fast-growing to cover the soil quickly); timely sowing (suppresses weeds); quality seeds (free of weed seeds); proper soil management (avoid weed seed to germinate); and undersowing, mulching and pasturing. All these methods make a substantial contribution to weed management. The successful implementation of these preventive methods saves considerably on labour for later weeding operations.

2. Identify and monitor weeds

3. Mechanical control: Weeding operations, including manual (and mechanical) weeding by pulling up the weeds, or digging or cutting them with weeding tools (e.g. hoe). The main idea is to remove weeds from the field, or pull them out and leave them to wilt in the sun.

IPM in wheat

The major wheat pests in Afghanistan are Moroccan locust and sunn pest, rust and bunt diseases, and prevalent weeds such as wild oats, see Table 1.

Table 1: Pests in wheat production

Pests				
	Moroccan locust *(Dociostaurus maroccanus)* Moroccan Locust		**Sunn pest** *(Eurygaster and Aelia spp.)* Sunn pest	

Diseases	Weeds
Rust *(Puccinia spp.)* Rust **Bunt** *(Tilletia spp.)*	Various weeds, e.g. wild oats System of Wheat Intensification

IPM in potato

There are several important potato pests such as white flies, aphids, potato tuber worm, wireworms and the very problematic Colorado beetle. Moreover, bacterial and fungal diseases predominate in potato cultivation. Weeds are also a major concern. For a better understanding of the pests and their control methods please refer to:

1. USDA & UC Davis, 2013
2. UC Davis, 2014

Farmer Field Schools (FFS) are a good way to introduce IPM. Figure 3 shows a FFS on IPM in wheat.

Figure 3: FFS on wheat IPM in Afghanistan (IPM-AF, 2014)

IPM in vegetables and horticulture

This is too big a topic to cover here due to the huge variety of vegetables, fruit and nut trees. However, intercropping or companion planting in vegetable production (see Box 3) is an interesting approach to balancing pests.

The following links are useful for IPM in vegetable and horticultural production:

1. USDA & UC Davis, 2013
2. UC Davis, 2014

Box 3: Intercropping (companion planting)

Intercropping is a useful IPM strategy in vegetable and horticulture production. Intercropping contributes to pest prevention by establishing a diverse ecosystem that attracts natural enemies and/or distracts pests.

The manual on companion planting in vegetable gardening is very useful.

Further reading and references

- FAO, 2014: Online information: http://www.fao.org/agriculture/crops/thematicsitemap/theme/pests/ipm/en/
- FAO, 2002: From Farmer Field School to Community IPM. Available at: http://www.fao.org/docrep/005/ac834e/ac834e00.htm#Contents
- FiBL, 2011: African Organic Training Manual. Module 4: Pest, Disease and Weed Management. Available at: http://www.organic-africa.net/1309.html?&L=0
- IPM-AF, 2014: Integrated Pest Management Project in Afghanistan. See http://ipm-af.org/
- USDA & UC Davis, 2013: Afghan Agriculture Portal. Available at: http://afghanag.ucdavis.edu/
- World Bank, 2011. Online information: http://www.worldbank.org/agriculture

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