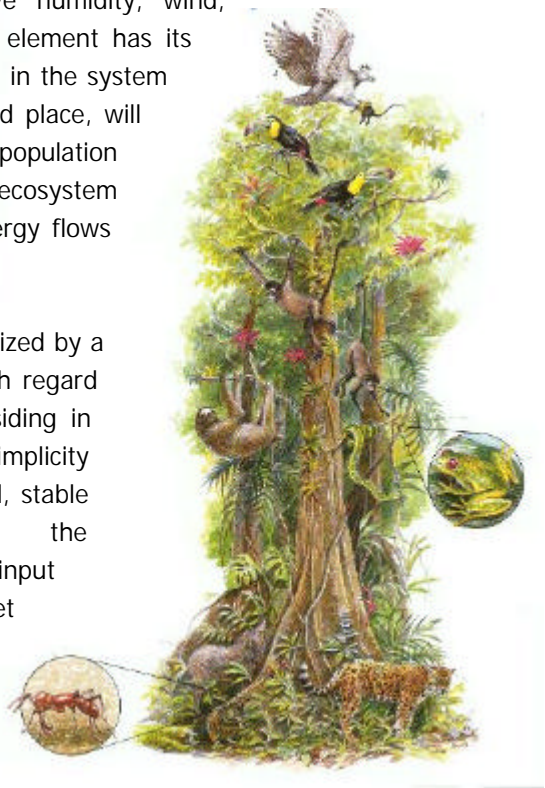


3 The agroecosystem

3.1 Introduction

An ecosystem is a natural system that is formed by dynamic interactions between biotic and non-biotic elements in a defined area. Biotic elements include plants, insects (pests, natural enemies, decomposers), microbes and other living organisms, and non-biotic elements comprise weather components such as temperature, relative humidity, wind, sunshine, rain and soil. Each element has its special characteristics and role in the system that, as a function of time and place, will influence the distribution and population of living organisms. The term ecosystem also involves nutrient and energy flows within the system.

An agroecosystem is characterized by a much simpler composition with regard to the number of species residing in the system and the relative simplicity of energy flows than a natural, stable ecosystem. Therefore, the agroecosystem needs energy input to maintain its balance. The wet paddy ecosystem, although an artificial system, has a rather complex composition of biotic and non-biotic elements, providing it with



relative stability. Injudicious use of pesticides, however, disturbs this balance due to the killing of natural enemies and other organisms in the rice field.

The IPM and ICM concepts find their basis in the stability of the agroecosystem and in economic efficiency. By maintaining the stability of the agroecosystem, pest populations can be kept at manageable levels. To achieve this, the following important points need to be remembered:

- A. Each ecosystem is dynamic with respect to numbers, position, role and intensity of each element within that transform and develop continuously. They form a living, ever-changing system.
- B. Each ecosystem contains a hierarchical structure. For example: plants are producers of vegetable food which will be used to feed herbivores. The herbivores (including pests) eat the plants using various modes of attack. The herbivores, in turn, serve as food for the carnivores (including the natural enemies), which again may be eaten by other carnivores. Finally, all organisms serve as food for the decomposers. In the agroecosystem, if no natural enemies exist, the pests will multiply unlimitedly and destroy the crop. But if the crop is finished, the pests will die of starvation. Many natural enemies are not choosy about their food and will eat other organisms, such as decomposers or plankton eaters, when there are no pests. Hence, they form an important protection mechanism in the field.
- C. All elements of the agroecosystem are strongly linked and disturbance of one element disturbs the whole balance. Therefore, the task of farmers is to maintain the natural balance among elements in the agroecosystem, ensuring a good environment for the crop to grow well.

3.2 Biodiversity

A healthy ecosystem has a high degree of diversity, both with regard to number of species and to genetic diversity among individuals within one population. In practice, it means that we can see various kinds of plants and animals. Some beneficial animals include earthworms that help increase soil fertility, and natural enemies such as spiders, beetles, frogs and lizards, that help suppress pest populations. If we do not find many of these beneficials in an agroecosystem, there is a problem caused by one of the following reasons:

- Too many pesticides are being used that killed the beneficials.

- There is not enough food for the natural enemies. The larval stages of most natural enemies eat other animals such as caterpillars and leafhoppers, whereas the adults may live on honey or pollen produced by wild plants in the environment. The adults should eat adequate food to be able to produce eggs and, thus, the next generation. Therefore, a variety of plants is needed to maintain the populations of these natural enemies. The more diverse the vegetation in an agroecosystem, the more diverse also the natural enemy populations, hence the more likely that pest populations will be controlled naturally.
- Soil texture does not support the life of earthworms and soil insects. Unfavorable conditions for the soil inhabitants are often caused by low organic matter content or prolonged inundation of a field. The soil becomes hard and/or short of oxygen. The disappearance of the soil organisms will cause further deterioration of the soil.

3.3 *Observing the crop and its environment*

3.3.1 *Why should we do routine observation?*

Field observation is the key to make appropriate crop cultivation decisions. By observing the field and its surrounding environment thoroughly and regularly, farmers will know exactly what the conditions in the field are like. Hence, they do not have to be afraid of any unexpected problems, such as a pest outbreak or drought. They can always handle an upcoming problem in time.

For a crop like sweetpotato, weekly observations are considered frequent enough to anticipate problems, unless the weather or water supply conditions are unfavorable, or when a pest population develops more rapidly than the natural enemy populations. After each observation we should determine when we have to do the next observation, based on the conditions found in the field. Field observation can be done best during the morning hours before 10:00 a.m., because later in the day the sun becomes too hot, causing most insects to hide in cool, dark places.

3.3.2 Observation of the environment

Observation of the surrounding environment of the field helps us to identify and understand sources of problems that appear in the field. If there is no obvious problem, observation of the environment can be done superficially by looking at:

- The weather condition.
- The condition of the soil.
- The condition along the edge of the field (bunds, ditches, roads) with regard to potentially harmful plants and animals (weeds, pests) or beneficial ones (natural enemies, plants providing food and shelter for natural enemies).
- The condition of the neighboring fields with regard to crop damage as an indicator of the existence of a source of pests and/or diseases.

3.3.3 Crop observation

In order to draw conclusions about the condition of the crop and actions to be taken, we do not have to observe the entire field. A representative sample would be sufficient. Based on the sample we can make a decision about what has to be done. The sample contains at least ten observation points on an area of 1,000 m². These ten observation points in a field are selected randomly on a diagonal line, i.e. from corner to corner crossing through the center of the field. Crossing through a field is important so that both edges and center areas are represented in the sample, since conditions (e.g. water, pest occurrence) may vary from place to place in a field. Some pests only eat at the edges (e.g. mole crickets), while others prefer the center of the field (e.g. rats).

To determine the location of each observation point in a random manner, we could walk a certain number of steps from one point to another and observe the spot in front of our feet at the last step. For instance, if the length of the diagonal line cutting through the field is about 75 m (100 steps), the distance between observation points should be 7.5 m or 10 steps. We should avoid to purposely select observation points with either good or bad looking plants. For sweetpotato, one observation point should cover an area of 0.5 m² across the

width of the ridge, or 0.5 by 0.5 m in the case of raised beds. Observation should be done in the following sequence:

- Observe anything flying above the foliage (e.g., dragonflies, butterflies), and on the foliage (e.g., ladybird beetles, rove beetles, web spiders, grasshoppers).
- Lift the vines carefully to see what can be found in the foliage and on the soil surface (e.g., hunting spiders, ants, rove beetles, frogs).
- Check all leaves and vines one by one for insects (e.g., leafeating caterpillars, aphids, thrips), diseases and nutrient deficiency symptoms.
- Remove some soil so that the roots are partly exposed, and observe the growth stage of the storage roots. Check for damage by weevil or other insects on the roots.
- Observe the condition of the soil (structure and moisture).

