Agroecological Crop Protection in South East Asia

Rice field bordered by flower strips

Photo: Nguyen Thi Thanh Thuy, (Plant Protection Department, Hau Giang Province)

Applying the principles of agroecology to crop protection

Intensive agriculture, based on 'green revolution' practices such as monocultures, agro-chemical inputs and intensive tillage with high level of fuel consumption, has helped to meet the rapidly-growing needs of global populations and markets. Yet, agricultural intensification also has devastating effects on the environment, affects farm profitability and impacts human health, of farmers and consumers. Especially the non-guided use of chemically-synthesized pesticides now poses real social problems that occur across the globe, and is having devastating consequences for wildlife and world's biodiversity. Such a situation can only be remediated by a paradigm shift, an increased attention to applied (on-farm) research and grower education, and a deliberate promotion of practices that safeguard nature and the environment.

In Asia, Agroecological Crop Protection (ACP) has a long and rich history. In fact, the oldest example of ACP pertains to the conservation of weaver ants (*Oecophylla spp.*) by farmers in ancient China and Vietnam, to control insect pests in citrus orchards.

ACP is a crop protection concept based on ecological principles, which aims to make agroecosystems more sustainable. In other words, ACP is a crop protection practice that boosts sustainability and resilience of the world's farming systems, and is guided by ecological techniques.

ACP results from a systematic implementation of agricultural practices through systemic and participatory approaches, gives priority to preventative measures instead of curative approaches and places emphasis on the protection and encouragement of beneficial organisms (i.e. arthropod predators, parasitoids or pathogens of pests, pollinators and recyclers of organic matter).

Essentially, ACP uses ecological practices and principles for crop protection. The aim of ACP is to promote the ecological function within farming systems by directly or indirectly optimizing interactions between plants, animals and microbial communities. Soil health and biodiversity are the two main pillars of ACP. They bring about an effective balance in cultivated populations as well as resilience against biotic stresses, and reduce

Photo : Antoine Franck (Cirad)

Syrphird larva feeding on aphids

Photo : Antoine Franck (Cirad)

Syrphird adult pollinating a flower

the risks and intensity of infestations, infections, outbreaks, epidemics and pest invasions.

Crop protection at a crossroads

In the field of crop protection, Integrated Pest Management (IPM) has been the prevailing paradigm since the 1950s, founded upon concepts devised by Californian entomologists. However, today it appears more and more obvious to scientists that it is very challenging to successfully combine biological control (based on promoting beneficials) with chemically-based pest management (which affect these beneficials), and that, contrarily to the underlying concept, IPM has often been implemented with high levels of pesticide use.

From theory to practice: implementing ACP practices

ACP practices are brought in through the universal phytosanitary strategy of halting pesticide treatments, implementing preventive measures (prophylaxis, varietal resistance or tolerance, avoidance of pest attacks, habitat management, soil management) and other phytosanitary and crop techniques compatible with ACP and Conservation Biological Control, such as physical barriers, or mulch-based cropping systems). ACP does not prohibit the use of curative measures if required, including the use of selective chemical pesticides as a last resort and under strict control, so as not to jeopardize the biological measures put in place.

This strategy involves a close examination of the functioning of agroecosystems, and the close interplay between plant communities (i.e. crops, companion plants, weeds), animals (arthropods and nematodes pests and auxiliaries), associated microbial communities (including pathogenic organisms as beneficial biota). In addition, the soil (and especially a healthy soil) and the soil-inhabiting detritivore community constitute the basis of a healthy and functioning food web, and contributes to the health of the cultivated plants. Early detection of any risk to have timely treatment by agroecological techniques would limit the problem spread (outbreak/epidemy) and any potential damage.

ACP is based on a systemic approach using expanded scales of space and time, given the dispersal potential and survivability of a number of pests and beneficials in the soil. Management strategies go beyond the field and crop management: they take place at the farm and landscape scale, thus requiring coordination between stakeholders (collective management). All stakeholders must be involved, particularly farmers, but also agricultural professionals in research, experimentation, training, knowledge transfer, local government and managers involved in landscape composition.

Solutions for the successful implementation of ACP in a given production situation

In recent years, progress has been made in the field of agroecological crop protection. This progress is the direct result of applying the principles of ACP in a given production situation. It should also be a reflection of a national policy to promote agroecology and the reduction of pesticide use. As it is still a novel approach, it has to be designed and implemented within the framework of a collective and participatory approach involving a large number of agricultural partners, led by farmers receptive to the agroecological approach. Those partners range from research and the professional sector, through experimentation, training, advisory services, teaching and transfer operations. The added socioeconomic and ecological value of ACP is also recognized.

Applying some principles of ACP in the field

Photo: Jean-Philippe Deguine (Cirad)

▲ *Incorporating organic matter in a vegetable cropping system*

Photo: Philippe Cao Van (Cirad)

▲ *Weaver ants carrying a worm to their nest*

Principle 1. Conservation biological control is key to ACP and the following practices should be applied: immediate cessation of pesticide treatments; the creation of habitats which encourage auxiliaries and discourage pests; integrating these elements and designing cropping systems and crop management plans which help preserve auxiliary populations. Other forms of biological control (inundative release, for example) can then be used effectively.

Principle 2. Improving biodiversity requires correct management of agroecosystems in time and space: management/orientation of the resident flora; diversification of crop rotation; introduction of multi-service cover crops; insertion of mixed crops or varietal mixtures; management of agroecological infrastructure (flower strips, hedges, wastelands, ditches, embankments, corridors); reconfiguration of the geometry and size of crop plots if they are unsuitable or too large: the quantity, size and nature of this plant biodiversity may be changed. Promoting plant biodiversity promotes animal biodiversity. The optimization of the interactions between these two types of communities is key to good ecological health and function (see previous principle).

Principle 3. Improving soil health involves optimizing interactions between permanent soil properties, climate and agricultural practices. The aim is to improve soil quality (organic matter, structure, physico-chemical properties such as pH and oxidation-reduction potential and biological function) and to protect soil against erosion and evapotranspiration using environmentally sustainable farming practices which discourage the development of pests. Plant health is improved and its susceptibility to attacks is reduced.

Principle 4. Agricultural practices which help crops withstand different biotic stresses, including pest and pathogen attacks and competition with weeds, should be adopted. This can be achieved through a combination of techniques: use of resistant or tolerant varieties, adapting management to make crops less susceptible to attacks (avoidance strategy, choking, or by modifying the architecture or physiological conditions of plants to deter pests (changing the date and density of sowing, fertilizer application, irrigation, or trimming, for example).

Some examples of ACP development in SEA

Agroecological management of Fruit Flies
Cassava mealybug biological control
Using weaver ants as biocontrol agents in citrus orchards
Agroecological rice protection in the Mekong delta
Improving soil health by biofertilizers and bioproducts
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Photo: Philippe Cao Van (Cirad)

▲ *Field trip in a farm near Can Tho*

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