LOW-EXTERNAL INPUT FARMING SYSTEM-STRATEGY FOR ENVIRONMENTAL PROTECTION

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INTRODUCTION

Most scientist today would agree that conventional modern agriculture faces an environmental crisis. Serious problems such as land degradation, salinization, pesticide pollution of soil, water and food chains, depletion of ground water, genetic homogenity and associated vulnerability raise serious question regarding the sustainability of modern agriculture. The causes of the environmental crisis are rooted in the prevalent socioeconomic system, which promotes monocultures and the use of high input technologies and agricultural practices that lead to natural resources degradation. Such degradation is not only an ecological process but also a social, political and economic process. While productivity issues represent part of the problem of natural resource degradation, addressing the problem of agricultural production must go beyond technological issues and include attention to social, cultural and economic issues that account for the crisis as well. Today as more and more farmers are integrated into international economies, imperatives to diversity disappear and monocultures are rewarded by economies of scale. In turn, lack of rotations and diversification take away key self-regulating mechanisms, turning monocultures into highly vulnerable agroecosystems dependent on high chemical inputs.

Any crop production system can be subdivided, on the basis of component elements, into inputs, biological processes and depletions or net losses. The biological processes include photosynthesis, genetics of the crop in terms of its adaptation to the soils and climate and resistance to pests and diseases, biological nitrogen fixation, nitrogen cycling in the soil, phosphorus uptake by mycorrhizal fungi associated with roots, plant defence by plant-associated microorganisms and natural enemies of insect pests and soil sanitation by the natural soil microbiota. The inputs include the fertilizers, water, where irrigation is practiced, pesticides, labour and energy. The depletions or net losses are largely earth resources and include the organic matter and mineral nutrients contents of the soil, water reserves and water quality, soil lost through erosion and fossil fuels.

The relative contributions of these three component elements to crop production on any given farm vary with the farming system. Some systems attempt to reduce inputs and make greater use of biological processes; other use more inputs and depend less on biological processes. These components refer only to those elements that are involved directly in crop production and do not include broader considerations such as food safety.

CONVENTIONAL FARMING SYSTEM

The technologies allowing the shift toward monoculture were mechanization, the improvement of crop varieties, and the development of agrochemicals to fertilize crops and control weeds and pests. Government commodity policies these past several decades encouraged the acceptance and utilization of these technologies. As a result, farms today are fewer, larger, more specialized and more capital intensive. At the regional level, increases in monoculture farming meant that the whole agricultural support infrastructure (i.e. research, extension, suppliers, storage, transport, markets, etc.) has become more specialized. Conventional (high input) technologies in crop production involve much intensive tillage systems, artificial fertilizers application, and substantial increase in the use of pesticides. The loss of yields due to pests in many crops (reaching about 20-30% in most crops), despite the substantial increase in the use of pesticides (about 500 million kg of active ingredient worldwide) is a symptom of the environmental crisis affecting agriculture. It is well known that cultivated plants grown in genetically homogenous monocultures do not possess the necessary ecological defense mechanisms to tolerate the impact of outbreaking pest populations. Modern agriculturists have selected crops for high yields and high palatability, making them more susceptible to pests by sacrificing natural resistance for productivity. On the other hand, modern agricultural practices negatively affect pest natural enemies, which in turn do not find the necessary environmental resources and opportunities in monocultures to effectively and biologically suppress pests. The great problems occur in final products, pesticides and fertilizers residues in food. These residues cause the great problems in human health as well.

ENVIRONMENTAL PROBLEMS CAUSED BY CONVENTIONAL FARMING SYSTEM

The specialization of production units has led to the image that agriculture is a modern miracle of food production. Evidence indicates, however, that excessive reliance on monoculture farming and agroindustrial inputs, such as capital-intensive technology, pesticides, and chemical fertilizers, has negatively impacted the environment and rural society. Most agriculturalists had assumed that the agroecosystem/natural ecosystem dichotomy need not lead to undesirable consequences, yet, unfortunately, a number of "ecological diseases" have been associated with the intensification of food production. They may be grouped into two categories: diseases of the ecotope, which include erosion, loss of soil fertility, depletion of nutrient reserves, salinization and alkalinization, pollution of water systems, loss of fertile croplands to urban development, and diseases of the biocoenosis, which include loss of crop, wild plant, and animal genetic resources, elimination of natural enemies, pest resurgence and genetic resistance to pesticides, chemical contamination, and destruction of natural control mechanisms. Under conditions of intensive management, treatment of such "diseases" requires an increase in the external costs to the extent that, in some agricultural systems, the amount of energy invested to produce a desired yield surpasses the energy harvested.

LOW-EXTERNAL INPUT FARMING SYSTEM

Implementation of low-external input technologies in field and vegetable crops is very important in sustainable development concept. Sustainable agriculture is a goal aimed at not only allowing no net depletions or net losses in earth resources but, ultimately, at rebuilding or restoring the productive capacity of agricultural soils as well.

From a management perspective, the agroecological objective is to provide a balanced environment, sustained yields, biologically mediated soil fertility and natural pest regulation through the design of diversified agroecosystems and the use of low-input technologies. The strategy is based on ecological principles that lead management to optimal recycling nutrients and organic matter turnover, closed energy flows, water and soil conservation and balanced pest-natural enemy populations. The strategy exploits the complementarities and synergisms that result from the various combinations of crops, trees and animals in spatial and temporal arrangements. These combinations determine the establishment of a planned and associated functional biodiversity which performs key ecological services in the agroecosystem.

Adoption of low-external input technologies including:

- New genotypes implementation with great adaptability to low-input system;
- Conservation tillage systems (more than 30 % of land surface were covered with organic residues, mulch tillage);
- Adaptive fertilizing system- mostly organic fertilizers;
- Ecologically based weed management;
- IPM-integrated pest management;
- Crop rotations intensification and diversification (intercropping, cover crops, mixed cropping, alley cropping);
- Increased economic efficiency.

The optimal behavior of agroecosystems depends on the level of interactions between the various biotic and abiotic components. By assembling a functional biodiversity, it is possible to initiate synergisms which subsidize agroecosystem processes by providing ecological services such as the activation of soil biology, the recycling of nutrients, the enhancement of beneficial anthropods and antagonists, and so on. In other words, ecological concepts are utilized to favor natural processes and biological interactions that optimize synergies so that diversified farms are able to sponsor their own soil fertility, crop protection and productivity. By assembling crops, animals, trees, soils and other factors in spatial/temporal diversified schemes, several processes are optimized. Such processes (i.e. organic matter accumulation, nutrient cycling, natural control mechanisms, etc.) are crucial in determining the sustainability of agricultural systems.

Agroecology takes greater advantage of natural processes and beneficial on farm interactions in order to reduce off-farm input use and to improve the efficiency of farming systems. Technologies emphasized tend to enhance the functional biodiversity of agroecosystems as well as the conservation of existing on-farm resources. Promoted technologies are multi-functional as their adoption usually means favorable changes in various components of the farming systems at the same time. For example, legume based crop rotations, one of the simplest forms of biodiversification can simultaneously optimize soil fertility and pest regulation. It is well known that rotations improve yields by the known action of interrupting weed, disease and insect lifecycles. However, they can also have subtle effects such as enhancing the growth and activity of soil biology, including vesicular arbuscular mycorrhizae (VAM), which allow crops to more efficiently use soil water nutrients.

Another practice is cover cropping or the growing of pure or mixed stands of legumes and cereals protect the soil against erosion; ameliorate soil structure; enhance soil fertility, and suppers pests including weeds, insects, and pathogens. Cover crops can improve soil structure and water penetration, prevent soil erosion, modify the microclimate and reduce weed competition. Besides these effects, cover crops can impact the dynamics of orchards and vineyards by enhancing soil biology and fertility and by increasing the biological control of insect pest populations.

Critics of such alternative production systems point to lower crop yields and in high-input conventional systems. Yet all too often it is precisely the emphasis on yield a measure of the performance of a single crop-that blinds analysts to broader measures of sustainability and to the greater per unit area productivity obtained in complex, integrated agroecological systems that feature many crop varieties together with animals and trees. There are also cases where even yields of single crops are higher in agroecological systems that have undergone the full conversion process.

Low-external input technologies implementation and adoption in food production is expected. All of this will be contribute to rational management based on existing resources on the farms. It will be contribution in safe food production and spreading of ecological consciousness. In that way of food production will be implemented the international standards in crop production and adjust ours with international regulations. Farming systems aimed at minimizing or eliminating the net-depletion element will also reduce many of the external costs of agriculture to society such as the cost of soil and other pollutants in lakes and rivers.