Guiding thoughts for the implementation of integrated farming systems in China

3. GUIDING THOUGHTS FOR THE IMPLEMENTATION OF INTEGRATED FARMING SYSTEMS IN CHINA

3.1. Sustainable development concept

Almost three decades have passed since the American biologist Rachel Carson published her book 'The Silent Spring'. She captured the imagination of the public with the graphic picture she drew of a world in which, as a result of the indiscriminate use of pesticides, the song of the birds at spring time would be lost for ever. Suddenly there was a new awareness that natural resources are not unlimited, and nature is no bottomless pit for pollutants and man generated wastes. The research of the Club of Rome and findings of the IGBP have shown us limitations of primary productivity and the potential limits of growth in the future. No matter how many different ideas have been expressed about these works, they have played an important role waking up the world's people. They were asleep in a deep dream of triumph in conquering nature. The people have since started to rethink the cost they have paid for their 'victory' and to seek a way to regulate the relationship between man, resources, environment and development.

Two important events are particularly worth mentioning here: the launching of UNESCO's Man and Biosphere Program in 1971, and the United Nations Conference on the Human Environment, held in Stockholm in 1972. Both programs laid emphasis on the vital feature of man's role in the ecosystem, and promoted the further improvement of rational utilization of natural resources and better environmental management through the efforts of different channels using multidisciplinary approaches.

For quite a long period, however, the ecologist and the people in the development department went their separate ways. It seems that development and conservation are incompatible. The contradiction between environment and development is that 'the environment is frequently placed in jeopardy by development'. It seems that if you want to have development, you must take the risks of environmental damage.

This situation did not improve until the concept of sustainable development was created. This concept has received increasing recognition from the public of different countries of the world.

The term 'Sustainable development' came into wide-spread use after the 1972 Stockholm UN Conference on the Environment, attended by 116 nations. Since then, more applications of environmentally sound development have

taken place in the world. Especially two publications brought the concept of sustainable development to the attention of the whole world; the publication of the 'World Conservation Strategy' (1980) by IUCN, UNEP and WWF in collaboration with FAO and UNESCO, and the very influential Report, 'Our Common Future', prepared by the World Commission for Environment and Development (WCED 1983), an urgent call to address environmental issues by the UN General Assembly.

According to the WCED report, 'Our Common Future', sustainable development is a process of change in which the exploitation of resources, the direction of environment, the orientation of technical development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations (1987). The WCED report defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (1987). The assumption of sustainable development is that humans have the ability to make development sustainable.

Environmental management is only recently being seen less as a road-block to economic development than as a necessary prerequisite for it. The time has come for a marriage of economy and ecology, so that governments and the people can take responsibility for the policies that cause damage. That conservation and sustainable development are interdependent can be illustrated by the plight of the rural poor. The dependence of rural communities on living resources is direct and immediate. For the 500 million people who are malnourished, or the 1500 million people whose only fuel is wood, dung or crop wastes, or the almost 800 million people with an income of $50 or less a year - for all these people conservation is the only thing between them and at best abject misery, at worst death. Unhappily, people on the margins of survival are compelled by their poverty to destroy the few resources available to them. The vicious circle by which poverty causes ecological degradation leading to more poverty can be broken only by development.

The sustainable concept should be functioning not only as a guiding thought and declaration used in policy statements but should also play the role of an operating concept or planning strategy in the management of earth resources.

Some leading ecologists have adopted a more pragmatic approach, stating that these problems may be resolved if approached in a more comprehensive manner. ODUM (1989) urges that a more holistic way of thinking and action must be adopted to reduce regional stresses. He advocates a unified approach to the management of a region through cooperative planning by agronomy, forestry and industry.

Similarly, there is an increasing interest in bringing together the more basic and applied aspects in environmental sciences. Other authors in the same series point to the false dichotomy between ecology and agriculture sciences and to the successful converging of ecologists and agricultural scientists within agro-ecosystem science.
The integrated farming system is but one approach toward transforming the idea of sustainable development from a concept into reality. Whenever we design an integrated farming system we must keep in mind that conservation can be integrated with development by means of anticipatory environmental policies, coordinating mechanisms which ensure that a cross-sectorial integrated approach is used in solving the challenges we are now facing.

3.2. Integrated approach

Two features characterize our time. The first is that the present scope and rate of change and man's ability to effect change are unprecedented in the history of human kind. Second is the interconnectedness between countries and different departments. During recent years, the state of the world resources base and environment has continued to deteriorate, despite efforts to improve the situation. The failure thus far to successfully meet these challenges can be explained by the institutional deadlock prevalent in nearly all countries. Most institutions and sciences are organized along sectorial lines, making it difficult to deal with problems requiring a holistic approach.
The integrated farming system is not merely a combination of different crops/animals in space or time, it is also not merely a land use system, but rather a kind of integrated rural development pattern. So the integrated farming system is not an activity of any individual sector or discipline in its right. Along with creating integrated measures for its proper management, a cross-sectorial cooperation and a multidisciplinary effort under consideration of biophysical, socio-economic, cultural and political aspects is necessary to better understand the system's behaviour, its response to the biophysical environment and its resilience under various environmental stress factors.

3.3. Economic-ecological principles

The designation and implementation of integrated farming systems should be based on ecological principles.
Many concepts play important roles in the understanding and development of

integrated farming systems. These are, to mention only a few, the ecosystem, community, energy flow, materials cycling, niche, succession, competition, food nets, species diversity, ecological adaptation, conservation of resources, ecosystem fragility, density dependent regulation, limiting factors, maximum sustained yield and carrying capacity, etc. According to the concept of the ecosystem, living organisms and their non-living environment are inseparably interrelated to each other. The biotic community in a given area interacts with the physical environment, so that a flow of energy leads to a clearly defined biotic structure and a cycle of materials between living and non-living parts. The productivity and structure, decomposition and succession, the cybernetic nature and the stability of ecosystems not only exist in natural ecosystems but also govern the development of man-made ecosystems such as our integrated farming systems.

The flow of energy and cycling of material are the basic interactions inherent in the ecosystems. Some incoming solar energy is transformed and upgraded in quality by the community (that is, converted into organic matter, a more concentrated form of energy than sunlight), but most of it is degraded and passes through and out of the system as low quality energy. Energy can be stored and then 'fed back' or exported, but it can not be reused. In contracts to energy, matter, including water and vital nutrients (carbon, nitrogen, phosphorus etc.) can be used over and over again. Food chains are another important concept for the implementation of integrated farming. According to the two laws of thermodynamics, energy inflow balances the outflow and each energy transfer is accompanied by a dispersion of energy into unavailable heat (i.e. respiration). Secondary productivity tends to be about 10% at successive trophic levels, although efficiency may be higher, say 20%, at the carnivore levels. The unavailable part of energy consists of two parts. One part is used in the grazing food chain and loses a great deal in the form of transpiration. At the same time a large amount of energy enters directly into the detritus food chain and participates in the biogeographical cycle without any economic effect.

Biogeochemical cycles are recycling pathways through which the chemical elements, including all the elements of protoplasm, tend to circulate in the biosphere in characteristic paths from environment to organisms and back to the environment. These more or less circular paths are known as biogeochemical cycles. The movement of the elements and inorganic compounds that are essential to life can be conveniently designated as nutrient cycles.

Although the flow of energy and cycling of materials exist both in natural and

man-made ecosystems, basic features of this process differ greatly between them. One distinct characteristic of the material and energy flow in man-made agricultural ecosystems is that a relatively high proportion of the produce is transferred to outside of the systems. In order to keep system sustainable, supplementary input of materials and energy should be provided through soil improvement measures, crop cultivation technologies, insect and pest protection measures and production processing measures. These subsidies come either from biological sources or from fossil energy. Thus in an integrated farming system, where the main purpose is the realization of sustainable development under environmental improvement and sustainable high productivity, the input of auxiliary energy is not refused. On the other hand, though energy can not be reused, we can regulate this process through the careful design of the composition and structure of the system as well as through the selection of appropriate agricultural techniques so as to obtain optimum economic efficiency, while sustaining a positive ecological balance.

The concept of limiting factors is valuable because it gives the ecologist an 'entering wedge' into the study of complex situations. Environmental relations of organisms are apt to be complex, but fortunately all possible factors are not equally important in a given situation or for a given organism. So primary attention should be given to those which are 'operationally significant' to the organism continuously during its life cycle. When we make an environmental impact statement or make an agroforestry designation, it is not to make long, uncritical lists of possible 'factors', but rather to achieve these more significant objectives: 1) to discover, by observation, analysis and experiment, which factors are 'operationally significant' and 2) to determine how these factors affect the individual, population, or community, as the case may be. In this manner, the effect of disturbances or proposed environmental alterations can be predicted with reasonable accuracy.

Ecosystems are rich in information networks comprising physical and chemical communication flows that connect all parts and steer or regulate the system as a whole. Accordingly, ecosystems can be considered cybernetic (from kybernetes = pilot or governor) in nature, but control functions are internal and diffuse rather than external and specified as in human engineered cybernetic devices. Redundancy - more than one species or component capable of performing a given function - also enhances stability. The degree to which stability is achieved varies widely, depending on the rigour of the environment as well as on the efficiency of internal controls. The stability actually achieved by a specific ecosystem depends not only on its evolutionary history

and on the efficiency of its internal controls, but also on the input of the environment and perhaps also on its complexity. Functional complexity seems to enhance stability, but cause-and-effect relationships between complexity and stability are little understood. Some suggested that a diversity of species should enhance the stability of the biotic community, but species diversity per se has not proven to be strongly correlated with stability. However, the theory of redundancy or congenetaxis suggests that a moderate diversity of species, each capable of performing key functions, should contribute to controlled responses.

For the development of an integrated farming system, the economic and social conditions must be taken into consideration. Reviving growth is one of the most important tasks of the successful development of any farming system in rural areas of developing countries, because that is where links between economic growth, the alleviation of poverty and environmental conditions operate most directly. This can be reached through 1. rapid rise in incomes; 2. reduction of risks in agricultural production; and 3. combination of long term target with short term and medium term benefits. The ecological farming system can provide different products to satisfy the needs of farmers for not only conventional crops but also sawwood, firewood, posts, poles, fruit, fodder, vegetables, medical products etc., so that farmers do not need to buy these products or transport them from far away. Many perennial crops are "standing capital" that can provide produce over a long period and insure against emergencies in case of immediate cash need. On the other hand, the long-term investment for the establishment of perennial crops may be considerably reduced by the short-term income from annual crops during the early stages of tree growth. In integrated farming systems dependency and catastrophes associated with monocultures are overcome or mitigated. There is more flexibility in the distribution of the work load over the course of the year. Well designed successful schemes of integrated farming allow higher productivity by means of associating the most desirable plant and animal species in space and time, at the same time allowing a gradual change from destructive land use practices towards more stable and ecologically sound system.