

## TOPIC 1

# ENVIRONMENTAL ASPECTS OF AGRICULTURAL DEVELOPMENT

### Scope

The developing world, which encompasses nearly two-thirds of the world's cultivated area and four-fifths of its population, produces only two-fifths of the world food supply. The adverse effect of pollutants which result from agricultural and socio-cultural developments are of paramount importance to developing countries which possess essentially agrarian economies. However, since agricultural development is not the only type of development involved in the total development of rural areas, it is difficult to isolate environmental problems resulting solely from agriculture from the problems resulting from rural-based industry and settlement.

In most countries the level of rural industrialization is low and increasing slowly, but emissions and effluents from some industrial complexes are already causing some harm to men, animals, and cultivated lands. Many industries which may pollute the environment are related to agricultural development (e.g., fertilizer factories, sugar factories and oil or pulp mills, and textile mills and tanneries). Thus, in developing agricultural programs it will be necessary to enlist the support of experts in devising low-cost technology for pollution control.

In most developing countries, traditional agricultural practices are not able to overcome the threats of plant pests (which inflict annual crop losses of between 33 and 46 percent), the menace of waterlogging and salinity (which reduce seriously the production potential of agricultural lands), and the unregulated systems of marketing agricultural produce (which result in enormous quantitative and qualitative losses of produce). At present most agricultural yields fall far below their potential. A low level of scientific technology in both plant and animal husbandry is one of the major causes of these sub-optimum yields of produce per acre or per animal. Such losses and low yields cause shortages in the food supply which may usher in unethical trade practices and lower the quality of life in all agrarian communities.

### Options

It is obvious that today's subsistence agriculture in the developing world must give way to new technology and a market-based economy. Both the needs of a growing population and the contribution of agriculture to the national wealth demand that agricultural development be given immediate priority. The gap between the expectations and the achievements of agrarian

communities is widening at an alarming rate. Unless tangible and effective efforts commensurate with the obvious needs are made, the gap can have serious social, economic, and political consequences.

Owing to the wide variations in the ecological, social, and political situations in developing countries, it is impossible to devise options or priorities which would be applicable in every case. However, there are two courses of action which apply universally: (1) fixing priorities for action programs on the basis of national needs, as directed by economic conditions and prevalent value systems; and (2) acquainting the decision makers, the planners, and the people themselves with the necessity for launching developmental programs. These can only be effective if they enlist the active support and participation of the people.

In the last decade, the disciplines of environmental science and technology have provided new genetic material, new farming techniques, and basic data which may be useful in providing solutions for agricultural problems. The effectiveness of the technological solutions can only be measured by the practical use of the knowledge. Much of this knowledge must come from the transfer of agricultural technology from one country to another by linking friendly enclaves all over the world. Then more projects must be planned and implemented using the best available information and technology.

### Guidelines

It is difficult and perhaps inadvisable to construct specific guidelines for the solution of agricultural problems and related environmental problems. The interactions of various ecosystems within a particular environment and the effect of agricultural development must be analyzed before effective remedial measures can be planned and implemented. These guidelines are therefore designed to be broad enough so that they can accommodate most action programs, at least in the initial stages. The suggested guidelines are:

- (1) In implementing agricultural programs, attention should be paid to the development of needed infrastructures to improve the quality of the environment, the integration and cooperation of various agencies, and the maximum participation of citizens.
- (2) Each action program should be preceded by surveys and ecological research to provide basic data from which the effectiveness of agricultural programs can be assessed and possible changes indicated.
- (3) A sound feed-back mechanism should be designed to link the centers of learning with the centers of extension work in the field, so that each developmental step is based on research relevant to the needs of the groups engaged in agriculture.
- (4) Effective mass communication media should be used to augment extension services, e.g., radio broadcasts directed towards rural areas, and handbooks which cover the problems, objectives, *modus operandi* of each program, and criteria for evaluating the effectiveness of the project.



- (5) Supplementary and complementary developmental measures should be introduced in the following areas: regulation of the system of marketing agricultural produce to avoid losses; crop insurance and credit; plant and animal protection measures against disease to raise production; applied nutrition programs to eliminate malnutrition; and literacy and vocational training campaigns.
- (6) Scientists and program administrators should emphasize the necessity for preserving the environment in the most aesthetic form possible.
- (7) Policy decisions on the improvement of the human environment in relation to the agricultural sector of the economy should be made in conformity with over-all national development plans and should cover such related fields as land use, land laws, banking, insurance, population, and family planning.
- (8) Even though development policies must be framed in relation to the country's national needs, internal policies and programs should be correlated with external agencies engaged in the same or similar work.
- (9) Since the knowledge from and the terminology of environmental studies are rapidly expanding, UNEP should prepare a current list of terms and their meanings which could be universally adopted.
- (10) Aid-dispensing agencies, especially those of the UN, should adopt a policy of providing assistance in the operation of developmental programs in developing countries, giving preference to those programs which have international impacts or which have a potential for producing useful models.
- (11) The possibility of establishing a new section within the UN Secretariat in concert with the FAO to handle agricultural development programs should be explored. A new section should simplify the present system of maintaining liaison among the various agricultural organizations engaged in development work in different areas and should render speedy advice on the transfer of agricultural technology affecting the environment from one country to another.
- (12) To make certain that agricultural development programs have a minimal effect on natural ecosystems, new legislation or expansion of existing legislation should be introduced to cover all aspects of agricultural development, whether plant or animal or their products and by-products.
- (13) The short- and long-term effects of agricultural development programs should be clearly understood, e.g., land tenure as it operates in different communities; mechanization as a labor-saving device in countries facing unemployment problems; the creation of large-scale farming systems in congested rural localities; and the use of irrigation, mechanization, and moisture conservation and their effect on changing the migratory patterns of human and animal populations.

### Research needs

Since so many of the people in developing countries are dependent on agriculture, the introduction of modern technology will profoundly affect the lives of much of the population. The varying impact which each environmental factor has on agriculture and the interrelationships of these factors as they affect agricultural development and production can perhaps best be studied through systems analysis techniques. Several environmental factors, for example, are important to the improvement of rice cultivation under irrigation: the characteristics and amount of the rainfall; evaporation, transpiration, and the resultant soil moisture level; run off and percolation resulting from the topography; cultivation practices and fertilizer use in regard to soil nutrient levels; and the potential reduction of yield by insect pests and diseases. Although the application of systems analysis depends on complete data, the analysis will point out the areas of data deficiency which then can be built into the research program. Researchers must also look for methods of generating data and minimizing the uncertainties created by the lack of moisture at critical periods and the infestation of insect pests or disease. Information on natural resources from space observations, fortunately, is now available from EROS Data Center, Sioux Falls, South Dakota, and interested organizations can contact the center for needed data.

The following is a list of the key research needs as defined by the conference. No priorities are implied; these must be established by each country in the light of the needs to be met and the resources available.

### General themes

- (1) As soon as possible, surveys should be initiated to determine what effect pollution from agricultural development is having upon the environment and upon human health and to formulate short- and long-term plans for reducing pollution.
- (2) Agricultural research data and technology from other nations should be made available to interested research institutions through the UN, the FAO (especially their documentation centers), and also through bilateral arrangements.
- (3) As far as possible, use should be made of the physical facilities of existing research institutes, particularly universities, to provide a basis for expanding research and development programs.
- (4) Research should center on specific problems in order of their priority in national development goals and plans.
- (5) In addition to studies on the specific environmental impact of agricultural development programs, national and regional studies should be undertaken on the effects of over-all development programs on the potential productivity of natural ecosystems.
- (6) Each problem or topic should have specific objectives, such as: major causes of a hazard; its intensity and magnitude in different localities or regions; the recurring economic losses incurred; the techniques avail-



able for control; the feasibility of applying specific technologies and their costs and effectiveness; modes of launching programs designed to control the hazard or ameliorate its effect; and the periodic review of present programs in terms of national and international impact.

### Specific themes

- (1) Food requirements and nutrition: annual supply of and demand for essential foods; the status of nutrition and health in rural and urban areas according to demographic groups; the causes of and remedies for quantitative and qualitative food shortages; the preparation of non-conventional foods; the enrichment of raw and processed foods; nutritional habits; nutrition and health education; and applied nutrition programs, including kitchen gardening.
- (2) Plant pests (diseases and weeds): types of damage and annual losses of crops caused by bacterial, viral, fungal, parasitic, and other agents; methods of treatment and control.
- (3) Animal diseases: types of diseases and annual losses of livestock and poultry caused by diseases in terms of mortality or morbidity; and methods of treatment and control.
- (4) Low crop yields: causes of low crop yields; methods to increase crop yields such as new farming techniques (mechanization and irrigation); land management; new plant varieties; and land tenure systems.
- (5) Low animal performance: investigations into breeding (specific purpose breeds adaptable to land conditions), management, and feed techniques.
- (6) Credit: the role of credit and insurance in agricultural development programs.
- (7) Pesticides, fertilizers, and other chemicals: application rates per acre; actual and potential harmful effects on land, water, vegetation, animals, and man in different areas; present and future trends in supply and demand; alternatives for those causing environmental problems; and suitable substitutes for those causing environmental problems.
- (8) Harmful flora and fauna: identification of harmful species of plants, insects, and animals; effects upon man and animals; the resistance developed by man, animals, and plants; the environmental factors (e.g., temperature and humidity) which alter their harmful effects; methods of prevention and treatment of maladies caused by harmful plants and animals.
- (9) Soil degradation: causes, intensity, and magnitude of soil depletion caused by waterlogging, salinity, erosion, and physical agents of change; methods of preventing damage and their comparative efficacy under varying ecological conditions; soil reclamation measures; **uses of depleted and reclaimed lands; management of pasture lands;** and causes, effects, and prevention of sand dune formation.

- (10) Produce losses: collection, storage, and distribution of produce; procedures for handling, transport, and storage of produce; processing and packing; methods of finance; and over-all weaknesses in the various systems of marketing.
- (11) Natural hazards: causes, frequency, and severity of natural hazards (floods, storms, drought periods); extent of damage to the agricultural sector; methods of monitoring and protection; and general studies on the adaptation of different forms of plants and animals to various climatic and ecological zones.
- (12) Agricultural settlements: designs of villages, homes, and farm structures; low-cost construction materials; sanitation; supply of potable water; disposal of used water; and agricultural wastes.
- (13) Agricultural population: causes and extent of agricultural population increase or decrease, including demographic and cultural aspects; local value systems, including coercive restraints and taboos, as well as attitudes towards change and innovation in agricultural operations; the role of women in agricultural development.
- (14) Illiteracy: causes, extent, and effects of illiteracy among various social and demographic groups; relationships between illiteracy and the modernization of agriculture; and methods of eliminating illiteracy in rural areas.
- (15) Effects of dam construction: changing irrigation procedures with dam constructions; the adverse effects of large dam constructions, including seepage and schistosomiasis.
- (16) Deterioration of water reserves: studies for zoning arable land according to the scarcity and abundance of water for drinking and irrigation; the quality of surface and underground water; the seasonal availability of water; water-shed management; losses of irrigation water through seepage and surface evaporation; and water conservation techniques under different physico-geographical conditions.
- (17) Deterioration of animal wealth: causes of rapid disappearance of serviceable animals, especially young stock, heavy milkers, and pelt producers; methods of preventing indiscriminate killing; possibility of the extinction of certain species of wild animals; feasibility of establishing gene-pools for scientific study and commercial gains; non-use of valuable animal products, such as blood, offal, bones, and trash fish; and the mismanagement of fish reserves.
- (18) Deterioration of plant wealth: causes, intensity, and effects of disappearance or deterioration of natural vegetal covers; variation in biomass and productivity in modified environments; and vegetal propagation and protection measures, including evolutionary trends.
- (19) Land use: where considered feasible, research should try to discover whether or not agricultural development schemes should be undertaken in the areas where natural productivity on a sustained yield

basis is superior to the potential long-term productivity derived from the envisaged agricultural development of the same areas.

- (20) Monitoring techniques: standard techniques should be developed, tested, and introduced for monitoring the state and quality of the rural environment for possible deterioration of the productive capacity of the land by pesticides and other chemicals and by waterlogging and salinization.