Part three

Environment related Information

Suggested Topical Areas to Focus On.

Environment and conservation encompass an enormous range of topics and issues, all of which are not appropriate, cost-effective or feasible to cover in a single meeting, or training. Consequently, the field worker and trainer should be selective about which environmental tonics should be included in the orientation, planning and training program and at what scope, and choose those that relate most directly to the prevailing environmental and socioeconomic conditions in the region. The programme planner or trainer will need to become familiar with a wide range of environmental issues when reorienting programmes for integrating environmental concerns.

Some household related issues are mentioned as examples in the planning steps described earlier, however the field workers and trainers will likely need to do some research and investigation into both local and non-local subsistence-based and commercial land use practices, government policies, and organizing training activities. For example, where crops are grown commercially for export or local markets, pesticide use may affect workers or neighbouring communities from atmospheric drift or runoff into groundwater, and have environmental impacts that extend well beyond the sprayed area. Knowing the various forms of herbicides and pesticides used in the country for various purposes, as well as what pest control training programs are already available for rural farmers, will be necessary before organizing the unit dealing with agrochemicals. Consequently, the field workers and trainers will need to become familiar with a wide range of environmental issues.

This section suggests a number of broad topical areas for consideration by planners, field workers and trainers for inclusion in the community dialogues and training curricula. The particular prescriptive or treatment measures for each topic will vary depending upon the conditions and circumstances prevailing in each region. For example, measures to control soil erosion, such as bench terracing or mulching, will differ greatly from one place to another. As such, specific issues, treatments and technologies will need to be identified within the community, based upon discussions with experts from related disciplines.

Sustainable agriculture and rural development

Trainers and field workers can help rural households reduce their vulnerability to food insecurity by assisting farmers in learning not only food production and resource conservation techniques, but also by informing farmers of broader sustainability concerns. Sustainable agricultural and rural development has become widely known as both an approach to and a goal of development programs (Eckman 1993). It has been variously defined as:

- "The management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable" (FAO 1988);

- "Development that meets the needs of the present without comprising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1990);

- "Development without destruction" (Commonwealth Secretariat 1992).

There has been growing interest in fostering sustainable agricultural and land use systems, to avert growing problems with land degradation. Broad environmental indicators have shown a continuing decline in the our physical condition, at the same time that living standards are also falling in many areas of Pakistan.

Confirmed statistics are not available for Pakistan, but in the last two decades, farmers have lost thousands of tons of topsoil to erosion, at a time when they were called upon to feed additional people. Environmental degradation, along with emerging agronomic constraints, is slowing the growth in food output. As water availability schemes for agriculture in Pakistan are facing controversy and less arable land is available for conversion to agriculture, all growth in output must now come from increasing productivity on existing cropland. But declines in the productivity of agricultural inputs such as fertilizers call into question the ability of farmers to increase their production. Irrigation and fertilizers are beyond the reach of most of the poor farmers, who rely primarily on rotation, manure and swidden methods to restore fertility to the soil. These trends indicate that rural households and national economy are increasingly vulnerable to food insecurity and environmental decline. If current predictions of population growth prove accurate and patterns of human activity on remain unchanged,

piecemeal conservation programmes may not be able to prevent either irreversible or continued poverty for much of the world.

Agroecology

The stability and sustainability of most indigenous agricultural production is based upon crop diversity. Subsistence-based farmers traditionally plant several crop species and several varieties within both time and space, to hedge against risk (Altieri and Hecht 1989). These cropping patterns are supplemented by the products derived from many native species collected from forests that also reduce household vulnerability. Preservation of traditional crop genetic resources, combined with the conservation of indigenous natural resources, are at the basis of agroecology.

Agroecology is defined as an approach to farming that promotes sustained yields through the use of ecologically sound farm management practices (Altieri 1983). The agroecology approach regards farm systems as ecologically integrated units, but with human influences on ecological processes. In agroecology, the intent is to maintain optimum nutrient and organic matter recycling, closed energy flows, balanced pest populations, and enhanced multiple use of the landscape (Altieri 1983). Agroecology relies on low levels of inputs, indigenous knowledge and appropriate technologies to achieve sustainable
agricultural production.

A sound understanding of natural ecosystems and human-managed ecosystems is a fundamental requirement for NRM specialists working with the rural support and other community development programmes, and is the basis for much extension information that is passed on to rural farmers. The following subjects are considered to be a basic introduction for the field staff and trainees with limited previous exposure to agriculture and ecology. They must at least go through these subjects to fit them in pre-existing agricultural and environmental conditions in their respective region.

Title of Topic: Agroecology

- The basic hydrological cycle (optional, depending on trainee level)

  Basic climatological/meterological processes

  Recyling of water through the hydrological cycle

- Review of the fundamentals of soils (optional, depending on trainee level)

  Basic structure and composition of soils Nutrient recyling

  Types, causes and effects of soil erosion

- Review of the fundamentals of plants (optional, depending on trainee level)

  Plant growth, development and reproduction

  Plant-environment interactions

  Plant ecotypes

  Effects of environmental stresses on plant communities

- Fundamentals of agroecology

  The biosphere
  Nutrient recycling (biotic and abiotic)

  Energy recycling through tropic levels: The food chain
  Communities and ecosystems

  Evolution and succession of natural ecosystems

  Biological diversity (preparatory introduction to later unit - see Chapter 8)

  Crop genetic diversity

  How limiting factors maintain population size

  Human influences on natural systems

  Farms as human-managed ecosystems (monocultures; polycultures)

  Nutrient and energy recyling in agriculture

  Agriculture and biological diversity

The ecological basis of insect pest, pathogen and weed management

- Prevailing biophysical/agroecological conditions existing in the country

  Abiotic resources: soils, rainfall, suitability for various crops, etc.

  Biotic resources: plant, insect, and animal communities

- Prevailing patterns of natural resource use in the country (agriculture, forestry, extractive industries, etc.)
- Prevailing types of farming systems in the country (slash-and-bum, agroforestry, pastoral, etc.)
- The role of households in satisfying basic needs
- Home economics, ecology, and environmental sustainability
- Near and far environments
- Issues of access to resources (distributive and tenurial relations)

Forest dependency

Forests are an important resource that support both national economic development as well as the subsistence needs of rural people. Forests also have many important ecological benefits, including the protection of soil and watersheds from erosion, as habitat for flora and fauna, the maintenance of biological diversity, and for hydrological and climatological stability.

In many areas, forests and trees grown on farms play an important role in contributing to many household needs in addition to food, and it is therefore difficult to separate the contribution forests and trees make to food security from the other benefits that they provide.

Trees are widely grown in agricultural systems in Pakistan, and provide a wide range of economic, aesthetic, and ecological benefits. Forests are also the source of a considerable array of wild foods and fruits consumed by rural households. Other uncultivated areas, such as grazing areas, streambanks, and drylands, may also provide a variety of roots, nuts and berries, honey, wild game or bush meat,

fish, and edible insects. These gathered foods are especially important during periods of drought, famine, or dry seasons. Consequently, conservation of forest resources through community can make a significant contribution to the environmental management and security of the rural households.

In rural households, forests are valued for a wide array of nonedible products that form an integral part of the household economy. Forests provide raw materials for construction of houses and farm structures, fodder for livestock, fencing, rope, handles for implements, and fuel-wood for cooking, indoor heating, and light.

Environmental degradation is a general decline over time in the condition of the natural resource base. It can seriously impact the economic security of rural households, as well as household nutrition. In the northern Pakistan regions people must rely on decreasing forest resources, impacting the availability of fuel, forest foods, fodder, housing materials, and other resources necessary for daily life. Deforestation is the result of tree cutting and clearing that exceeds natural regrowth. Excessive deforestation not only removes an essential economic resource base, but also contributes to a loss in biological diversity, increased soil erosion and a deterioration in water supply and availability. The loss of forest cover, biological diversity, and habitat can greatly affect the economic stability and resilience of rural households, and can represent a serious loss to the national resource base which supports economic development.

Environmental change may imply either improved or worsened food supplies, depending on the nature of the change. A country with adequate or even surplus food supplies may mean that some do not have access to food, and a distribution problem may exist. Where access or distribution problems occur, environmental degradation may result.

The general subjects given below are the most relevant for the field workers and trainers to study and adapt according to national and local conditions and opportunities.

- Overview: Importance of trees in farming systems

  To the household economy

  To the national economy

  To the environment (nutrient and energy recycling)

- The relation between forests, nutrition and food security; contribution of tree foods to the diet
- Trees and food production at the household level
- Social and economic aspects Income and employment from forests
- Uses of non-timber products
- Environmental links between trees and food security
- Resources: Where to go for further information on the topic (in-country)

Watersheds and water quality

Another critical environmental element affecting the quality of life of rural households is water and watersheds. Water is a fundamental resource necessary for rural life, and an essential element in any development strategy for the rural areas. Providing a reliable supply of usable water is also essential for human health and economic development (Gregersen et al.). With agriculture using two thirds of all freshwater taken from watersheds globally, it is essential to move toward more sustainable water use in rural areas (Brown et al. 1993). Industry, too, consumes water for manufacturing purposes, and often contributes to a decline in water quality through pollution and waste.

Watersheds are imaginary boundaries that chart the course of a stream as it drains from its source (headwaters) to downstream areas. Watersheds are important landscape features that provide rural populations with water, soil, pastures, wood, nontimber products, and other goods essential for the wellbeing of people. Water flows downhill regardless of regional boundaries or community limits, and upstream misuse of water can seriously affect the well-being of downstream communities through pollution and a deterioration of water quality. More water devoted to human needs means less for the sustenance of ecosystems.

Watershed management is an approach to guiding and using land and other resources on a watershed to provide goods and services without adversely affecting water and soil resources (Brooks, Gregersen, Lundgren and Quinn 1990). Embedded in the concept of watershed management is the recognition of the interrelationships of land use, soil, and water, and the linkages between uplands and downstream areas (Brooks, Ffolliott, Gregersen and Thames 1991). Watershed management is not only a set of tools and techniques (e.g. physical, regulatory and

economic) for responding to potential problems within a watershed, but also an integrative way of thinking about how all human activities in a watershed have effects on, or are affected by, water (Brooks, Ffolliott, Gregersen and Thames 1991).

Rural households that are positioned on a watershed, either upstream or downstream, are interdependent in terms of both water supply and water quality. The loss of forests, overgrazing, and improper cultivation practices also affect the quantity and quality of water supplies downstream.

In many countries economic growth, industrialization, and population growth has outpaced the supply of available water that can be sustained comfortably, causing serious water scarcities. More water devoted to human use means less for the sustenance of ecosystems (Brown et al. 1993). People need better access to information that can help them to conserve water resources, and avoid degrading the watershed. This is especially important for newer arrivals who cultivate higher, marginal slopes on the watershed, and who may bring with them farming practices more appropriate for flat lands.

Given the high investment costs of irrigation and of developing new sources of water supplies, it makes sense to focus on the sustainable use of water by rural farm families. Many donors are fuming toward the potential of smaller-scale water projects that emphasize conservation and re-use, such as water-conserving cultivation techniques, catchments, rainwater harvesting, and other techniques. These technologies can greatly improve food production and security in rural areas while using locally available resources. The challenge to community development programmes is to place information about such techniques in the hands of rural farmers, to improve their food and water security, and to maintain environmental quality.

Water quality as discussed in part two of this guide is a closely related issue that directly impacts the well-being and productivity of rural households. Water quality refers to the chemical, biological and physical condition of water, in terms of its suitability for human use, and in particular! for drinking. In areas that are overpopulated or that are experiencing environmental degradation, water quality generally suffers.

Water is a primary natural resource that is fundamental to life, well-being, and to the production of food, and as such, its availability and quality is of critical importance to rural households. A decline in water availability can quickly threaten the health and food security of a community. Broadening home economics curricula to include issues of water supply and quality is one of the most important means of addressing the immediate resource and information

needs of many rural households. The following elements generally relate to issues of watershed management and water quality and the field workers and trainers shall study them in detail for their knowledge.

- Overview of watershed management: What it is and why it is important
- Unique qualities of water as a natural resource
- Basic hydrological processes (hydrologic cycle; streamflow and runoff; groundwater, etc.)
- Erosion, sedimentation, and land use
- Upstream/downstream effects of land use; local and non-local impacts of watershed degradation
- Rural households, agriculture, and water management
- Issues of access/tenure to water sources
- Livestock and water
- Water quality
- Water harvesting and conservation methods
- Resources: Where to go for further information on the topic (in-country)

Biological diversity

Most of the development practitioners think that their poverty alleviation or other programmes have nothing to do with biological diversity, but this is due to their lack of understanding about the subject. Biological diversity, in fact, encompasses all of plants, animals, and microorganisms, and the ecosystems and ecological processes in which they live. Biological diversity (or simply "biodiversity") is defined as the variety and variability among living organisms and the ecological complexes in which they occur. As the fundamental building blocks for development, biological resources provide the basis for local self-sufficiency.

At the same time, biological diversity is a global asset, bringing benefits to people in all parts of the world (McNeely et al. 1990).

Rural households have an important and direct role to play in conserving the world's genetic resources. Worldwide, community members have primary responsibility for the selection and preservation of agricultural seeds and rootstock from one season to another. Rural people also have considerable knowledge about the characteristics, distribution, and site requirements of indigenous trees, bushes, and plants. Insects, constituting the largest number of species, are well-known to rural people for their economic utility, edibility, and other practical values. Traditional healers and birth attendants are a storehouse of information about indigenous plants and trees with medicinal or spiritual properties. Rural households have an important and direct role to play in conserving the world's genetic resources.

The local management of these genetic resources is crucial to the viability and sustainability of biological systems and to biological diversity. But where local management systems are threatened by demographic change, misguided policies, or other factors, biological diversity can be seriously affected. Deforestation, desertification, misuse of watersheds, and other forms of land degradation can also have serious impacts on the diversity of genetic resources in an area

The rapid destruction of the diverse ecosystems has led most experts to conclude that biological diversity is at serious risk of extinction particularly in the developing countries in Pakistan where the development and conservation programmes work in isolation from each other. Land and water degradation causes the loss of habitat for organisms such as fish, soil flora, birds, plants, and other organisms. Deforestation or burning of fields can destroy soil microorganisms that are important for maintaining soil fertility, and for decomposing biomass. The result can be a loss in soil fertility, and ultimately of agricultural productivity. Loss of biological diversity can also occur through pollution, over-harvesting (especially through the exploitative use of forests and water), climate change, by introducing new species (especially invasive or opportunistic plants) that replace native species, and by habitat alteration.

While the specifics of the problems will vary from one place to another, the main source of all these symptoms can be found in the distribution of costs and benefits of both exploitation and conservation. Those who have reaped the benefits from exploitation have not paid the full costs, and those who paid most of the costs of conservation have gained few of the benefits (McNeely et al. 1990).

In planning development programmes the planners and implementers should

seek to integrate issues of biological diversity with other related natural processes, so that the community members will have an appreciation of how human influences can alter genetic diversity and species composition. The economic importance of loss of biological diversity should also be stressed, as well as relevance of biological diversity to environmental sustainability. Suggested elements for the unit are summarized below.

The following areas need to be studied by the field workers in detail.

- Overview: Biological diversity: What it is and why it is important
- Why biological diversity is needed for local sustainability and for national economic development
- Types of biological diversity:
- Dimensions of the problem (locally, nationally, internationally)
- How human actions threaten biological diversity
- Maintaining diversity in the natural environment
- Managing farms for biological diversity
- Local knowledge and biological diversity
- Preserving biological resources
- Resources: Where to go for further information on the topic (in-country)

Carrying Capacity

Carrying capacity is the optimum resource utilisation capacity or population size that a given habitat can support indefinitely under a given set of environmental conditions (Jones et al., 1992). Exceeding the carrying capacity occurs when population densities exceed the ability of land to sustain increased levels of use without degradation. The growth in economy and the increase in population have begun to outstrip the carrying capacity of biological support systems without being damaged. Exceeding the carrying capacity occurs when the utilisation/harmful activities or population densities exceed the ability of land to sustain increased levels of use without degradation.

As carrying capacity is exceeded, additional stress is placed on land already utilized to the maximum. New land is brought under cultivation, in many cases land that is marginal or not suitable to cultivation. By the end of the century, shortage of land will have become a critical constraint for about two-thirds of the population of the developing countries. The socioeconomic and environmental consequences of exceeding carrying capacity are costly both to society and to national governments. Such costs can include irreversible environmental damage, increased conflict over land, water, pastures and forests, increased poverty and human misery, and added demands on national governments and international organizations for goods and services.

Increasing human and livestock populations are a major demographic feature of many countries, and result in increased demands for land, water, wood for construction and for fuel, forage, and for other natural resource goods and products. In response to these increased pressures, rural landscapes are changing dramatically. Population growth, land degradation, and rural poverty are interrelated problems that reinforce each other in a downward spiral, causing unsustainability at many levels: environmentally, economically and politically. The crisis of poverty is closely tied to the nature of local ecosystems for it arises in part out of growing scarcities in water, food, fodder and fuel which are associated with increasing ecological destruction (Thomas-Slater et al., 1991).

Environmental degradation contributes to poverty through worsened health, and by constraining the productivity of natural resources upon which the poor depend. Poverty restricts poor households to acting in ways that are damaging to the environment. As we have seen, demographic factors can be involved in complex ways: high growth rates are associated with rural poverty, and directly exacerbate problems of environmental degradation (Mink 1993).

In addition to affecting their health and capacity to work, environmental degradation depresses the ability of rural households to generate income in two ways. First, it requires the poor to divert an increasing share of their labor to routine household tasks such as the collection of fuelwood. Second, it decreases the productivity of those natural resources from which the poor obtain their livelihood, thereby perpetuating impoverishment (Mink 1993).

People are the ultimate resource and the community development programmes field workers should be most concerned with building the capacity of rural people to live sustainably with the resources available to them. Helping rural households to plan their families is an important positive step that extension workers can take to help people cope with these interlinked problems, and to reduce pressure on natural resources. Programs that translate economic growth

into education and health care, and contribute to human development, are essential to produce a better life for a nation's people (World Resources Institute 1992). The field workers can also help to present a more macro view to rural people who may have limited exposure to broader demographic trends.

Land use and land tenure

Land use and land tenure are concepts that describe important economic and social relationships between people and land. Land use has two distinct definitions:

1. Functional land use is the use of an area of land to meet the requirements of the inhabitants of the area;

2. Current ground cover is the present use of land, for example, for agriculture, industry, or housing (Jones et al. 1992).

In contrast, land tenure is a system of rights regulating the ownership or use of land, and the arrangement governing the relationship between landlords and tenants (Jones et al. 1992). Land tenure refers to the possession or holding of a bundle of rights associated with a parcel of land. This bundle of rights can be broken up, redivided, or passed on to others, either as individuals, groups of people, or political entities. The distribution of rights determines who has access to land and other resources in a rural community. The distribution of rights determines who has access to land and other resources in a rural community.

Tenure can be extended to other types of natural resources as well. It is not uncommon for tenurial rights to be extended to sources of water or streams, individual trees, forests, and other natural resources. Rights of access can become very complicated, and may overlap within a single place and time, with many people having certain rights of access to the same area. The same space may be used for different purposes by different groups of people at different times (Fortmann and Riddell 1985).

Land use and land tenure may have complex rules that govern how, when, and who use the land. Tenurial relations can be governed by customary, or traditional rules, religious rules or beliefs, and newer constitutional or gazzetted regulations. It is not uncommon for unwritten customary and written official rules to co-exist at the same time, especially in rural areas. In addition, tenurial access to a resource may be determined by gender, age, or other social status.

Land availability is becoming scarcer in many countries because of macro-level

economic and demographic changes. Increased privatization and commercialization of land, especially drylands, pushes farmers and herders onto more marginal lands, and limits their access to traditional grazing areas and water sources. Troublesome changes in tenurial relations governing access to natural resources, such as pastures and water can result.

The excessive fragmentation of agricultural land, along with the breakdown of many common property regimes, makes people less secure in their tenure, and less willing to take conservation measure if they believe that they will be forced to relocate (Gregersen et al.). Problems of land degradation are likely to increase in degree and in visibility in the future, as populations and economies continue to grow. Governments will be challenged to find sustainable solutions to these interlinked problems of poverty, population growth, and resource degradation. The field workers and trainers can support the efforts of governments by providing community members with a sound understanding of the complexities of land use and land tenure.

Tenurial patterns vary considerably even within a single province, and the field workers need to become familiar with the prevailing land use patterns and tenurial relations within their own country. In particular, trainers should seek to understand the degree to which customary and official rules governing land use and tenure exist within the country. The basic elements for study this subject are given as under:

- Introduction to land use systems
- Overview of prevailing land use systems in the country
- Introduction to tenurial rules and institutions

  Customary tenurial rules

  Official tenurial regulations
- Types of land tenure systems (e.g. gazetted land and other public tenure, private land, common property, open access, etc.)
- Changing patterns of land tenure and use in the country (e.g. privatization, settlement patterns, etc.)
- Tenurial relations and other natural resources

- Tree tenure
- Water tenure
- Tenure and religion (sacred or protected groves, watersheds, springs, etc.)

Conservation methods

Conservation is defined as the management, protection and preservation of the earth's natural resources and environment. Conservation implies not only the stewardship of natural resources, but also the maintenance of everyday life of human society. A conservation approach avoids disturbance or damage to natural systems and processes as much as possible.

Conservation methods are those techniques which enhance the diversity of plant and animal diversity, reduce erosion and other degradation processes, and rely on recycling of energy and materials to prolong the life of existing and future resources (Jones et al. 1992). There is a very wide range of conservation practices and methods that have been developed to conserve soil, water, vegetation, and other natural resources. Many of these are traditional methods that have evolved locally over many generations, and others are more recent technical methods developed by scientists.

Not all soil and water conservation methods will be appropriate for every environmental context, which will vary greatly from one region to another. As conservation methods and techniques tend to be specific to different ecosystems and environments, they will not be summarized here. The field workers are urged to consult a good reference work on conservation methods appropriate to prevailing local conditions.

Apart from the technical aspects of resource conservation, it is important that people be directly involved in planning and undertaking conservation efforts on a sustained basis. Because the condition of natural resources depends to a large extent on human use of those resources, the resource users themselves must be actively involved in conservation efforts, to avoid degrading the resource base. In many places people practice traditional or indigenous conservation techniques, that should be supported and encouraged by extension staff. Newer or "modern" conservation measures should be carefully assessed for compatibility with indigenous conservation methods prior to their introduction.

Pakistani government has also recognized the importance of conserving natural resource base, and IUCN in particular has developed conservation policies and

programs. The field workers and trainers of the development programmes are advised to learn as much as possible about existing conservation policies and programs in Pakistan, and incorporate them into the community material as appropriate.

Agrochemicals

Pesticides, fertilisers and other agrochemicals are widely used in the rural areas Pakistan, where a greater numbers of insect pests and plant diseases exist. Although agrochemicals have considerable potential to increase yields, widespread misuse has led to public health problems and the contamination of water and soils. The use of even more fertilisers and pesticide is being encouraged and no one has heard of a ban on any of the harmful product so far. DDT is still used in many parts of the country.

Pesticides are frequently applied without protective clothing, and are widely used by community members farmers who may be pregnant or breastfeeding. Pesticide runoff can affect water quality, and can be carried downstream so that distant dwellers are affected by contaminated water supplies. The health risks to rural families and downstream dwellers are high, yet most farmers are unaware of the dangers of unprotected exposure to agrochemicals.

Government policies and extension programs often support subsidized fertilizer, herbicide and pesticide use by rural farmers, especially where high-yielding "green revolution" varieties (HYVs) have been introduced. Most of the development programmes also encourage and finance farmers to extensively use fertilisers and increase the yield without keeping in mind that it would be a short term solution to the farmer's poverty.

The field workers should seek to relate the balanced use of agrochemicals with environmental sustainability and human health aspects. Alternatives to agrochemical use, such as organic nutrient recycling, biological controls, and integrated pest management, should also be introduced on the field and incorporated into the training curriculum. In addition, the economic trade-offs associated with the use or non-use of agrochemicals should be stressed. The field workers should become familiar with pesticide policies, programs, and patterns of use in the country before preparing this instructional unit, so as to target the instructional message to areas needing specific attention.

Some suggested elements on this subject are summarized below.

- Benefits of agrochemical use

- Types and action of agrochemicals
- Fertilizers (types and impacts)
- Herbicide (types and impacts)
- Insecticides (types and impacts)
- Other agrochemicals (types and impacts) (fungicides, soil fumigants, nematicides, rodenticides, diothiocarbamates, antibiotics, etc.)
- Pesticide toxicity
- Pesticide selectivity (broad spectrum agents have wider environmental impacts)
- Agrochemicals in agricultural ecosystems.
- Energy recycling (review)
- Nutrient recycling (review)
- Pest population dynamics (review)
- Household use for pests (mosquitos, rats, etc.)
- Problems associated with agrochemicals
- Environmental and ecological impacts of agrochemicals
- Costs and benefits of agrochemical use to rural households
- Alternative methods
- Social controls
- Integrated pest management
- Resources: Where to go for further information on the topic (in-country)

Pollution and waste

Pollution is the contamination of the biosphere with poisonous or harmful substances, usually agricultural, domestic, industrial, or chemical waste products. Pollution of the biosphere can cause undesirable changes in the physical, chemical, and biological makeup of the earth, and results in impaired performance, reduced growth, lowered reproductive capacity, and ultimately the death of individual organisms (Jones et al. 1992). Waste is unwanted, discarded material that originates from a variety of sources. Waste is the garbage or refuse remaining after consumption, that undergoes a process of decomposition after it has been dumped. Decomposing waste often creates pollution that can contaminate the soil, groundwater, and atmosphere, and may affect downstream communities.

Economic development is often based upon the growth of industries such as manufacturing, mining, logging, and agriculture. These industries use large amounts of materials and energy. The extraction and processing of raw materials are among the most environmentally destructive human activities. The overall aim in reducing pollution and waste is to reduce the amount of materials that enter and exit the economy (Brown et al. 1991). The overall aim in reducing pollution and waste is to reduce the amount of materials that enter and exit the economy (Brown et al. 1991).

Many industrialized and developing countries carry huge economic burdens from inherited problems such as air and water pollution, depletion of groundwater, and the proliferation of toxic chemicals and hazardous wastes. These have been joined by more recent problems - erosion, acidification, watershed degradation, new chemicals, and new forms of waste that are directly related to the agricultural, industrial, energy, forestry, and transportation base of the country (World Commission on Environment and Development 1990).

Various forms of chemical and waste pollution from industrial activities can threaten ecological stability and environmental sustainability, and negatively impact human health and safety. Pollution and waste can also affect the quality and well-being of human populations, both locally and globally. Airborne pollution from industrial sources or from slash and burn agriculture can affect air quality, and may contribute to global climate change. Soil and groundwater pollution from discarded wastes can migrate by underground movement, and affect people downstream or in distant communities. The impacts of pollution and waste are most concentrated along coastal areas in river estuaries and watersheds, that are frequently inhabited by smallholder farmers, market producers, and fishing communities.

At the level of the rural household, people may be affected by runoff from distant

sources. But rural households may also contribute to pollution problems in various ways. The widespread use of agrochemicals by farmers in countries like Pakistan is often done without adequate training, contributing to overuse, misapplication, or mistargetting. Agrochemicals are important sources of toxic atmospheric and groundwater contamination, with impacts on human health and reproduction. On a smaller scale, the disposal of batteries into household fields and gardens, for example, can leach pollutants and heavy metals that are taken up by plants and eaten by people.

Pollution and waste problems require not only global and national action at the policy level to deal with pollution stemming from industrialization, but also more locally-oriented programs oriented toward urban and rural households. Extension trainers should familiarize themselves with programs in their country oriented toward renewable energy, as well as the Three R approach to consumption of materials at the household and community levels: **reduce, recycle, re-use**.

Rural households have potentially a very significant role in controlling different forms of pollution, and in recycling reuseable materials. In particular, rural households could potentially and significantly reduce pollution and toxic runoff from agriculture, as well as household wastes. In addition, soil conservation measures can help reduce sedimentation and erosion that affects water quality to downstream users. But many households lack information on conservation methods and alternative technologies such as integrated pest management, composting, or organic methods to enable them to reduce their consumption of pesticides, to recycle materials, or to contain organic and inorganic wastes.

Subject matter in this unit will vary widely depending on the nature of waste and pollution problems in the country. Trainers will need to determine current levels and prevailing types of pollution and waste, as well as causes (point and nonpoint pollution, extraction of raw materials such as mining, industry, household resource consumption and disposal, etc.) and effects (downstream pollution, air quality, etc.) that are specific problems in their country.

Environmental Features for inventory.

Environmental and natural features should be inventoried and mapped with an emphasis on features that will influence growth and development in the community or that contribute to the overall quality of life for residents. Features that should be considered in this inventory follow.

WETLANDS

Can be defined as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands are extremely valuable and productive ecosystems. They are home to many threatened and endangered species of plants and animals. They are also the source of many commercially and recreational valuable species of fish, shellfish, and wildlife. Wetlands retain flood waters and protect coastal shorelines from erosion. Wetlands filter runoff and adjacent surface waters to protect the quality of our lakes, bays, streams and rivers. Wetlands also protect many drinking water sources as well as providing recreational areas.

RIVERS, LAKES AND STREAMS

Scenic river designation is an important step in the planning process of managing and protecting river related aesthetic, ecological and cultural values. This process combines input from local governments, planning agencies, quasi-public and private organizations and individuals to achieve balanced objectives of resource use and protection. Waterways are evaluated according to indigenous natural resource values, character and extent of man-made development, resource endangerment, and recreational use or potential. River conservation efforts are initiated by numerous organizations both public and private.

SURFACE WATER AND GROUND WATER

Fresh water occurs in two states: surface water and ground water. Surface water occurs in the form of streams, lakes, ponds, and swamps. Ground water is that water which has percolated from the earth's surface into the subsurface earth materials and has reached the zone where saturation of the subsurface materials occur. Thus, ground water is a veritable ocean of fresh water beneath the surface of the land masses of the earth. Both water sources are used for public and private drinking water sources.

THREATENED AND ENDANGERED SPECIES

All living things are part of a complex, delicately balanced network. The removal of a single species can set off a chain reaction affecting many others. The full significance of an extinction is not always readily apparent; and the long-term impacts are difficult to predict. The following criteria, in general, are used in determining whether a species is

considered endangered or threatened: Species or subspecies in danger of extinction throughout all or a significant portion of its range are considered endangered while species or subspecies which are likely to become endangered in the foreseeable future throughout all or a significant portion of its range are considered threatened. Species or subspecies which are uncommon within a state or region are considered rare.

PRIME FARMLAND, AGRICULTURAL AND SOIL CONSERVATION

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fibre, and oil seed crops, and is also available for these uses (the land could be cropland, pasture land, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favourable temperature and growing season, acceptable acidity or alkalinity, acceptable salt content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

SOIL SUITABILITY FOR SEPTIC SYSTEMS

Soil characteristics are of prime importance in determining soil suitability for onsite sewage/septic systems. Characteristics which affect site suitability include soil permeability (often expressed as a percolation rate), soil depth to bedrock and water table. Site characteristics such as slope and proximity to drinking water wells, streams and rivers, or lakes also plays key roles in determining site suitability.

Soils which are considered suitable for onsite septic systems have the ability to absorb, filter, and purify septic tank effluent. To do this, this soils must maintain an unsaturated condition and be of sufficient depth to allow for the decomposition of organic particles and compounds, biodegradation of detergents, and die-off of bacteria and viruses. Soils which are not suited for onsite septic systems ("limiting" soils) allow unfiltered sewage to either rise to the ground surface or seep into ground water. Sewage that reaches ground water without adequate

decomposition will not biodegrade in the aquifer because reducing bacteria are not present, thus contaminating the aquifer. Information on soil suitability of septic system development is available from local, state and federal agencies.

FLOOD PLAINS

A flood plain area is a relatively flat or low land area which is subject to partial or complete inundation from an adjoining or nearby stream, river or watercourse; and/or any area subject to the unusual and rapid accumulation of surface waters from any source. The flood way is the designated area of a flood plain required to carry and discharge flood waters of a given magnitude. The flood way shall be capable of accommodating a flood of the one hundred (100) year magnitude. A 100-year flood event is the highest event of flooding that, on average, is likely to occur every 100 years, that is, that has a 1.0% chance of occurring each year.

AIR QUALITY

The air quality of a region is representative of the levels of pollution and lengths of exposure above which adverse health and welfare effects may occur. Air quality standards have been developed to gauge level of pollutants not to be exceeded during a specified time period in a defined area.

ENVIRONMENTALLY SENSITIVE AREAS

Environmentally sensitive areas include important natural resources such as sensitive topographic features (i.e. steep slopes (›15%)), geologic/geomorphic formations, sinkholes; scenic vistas/overlooks/lookouts; and public and private forest and woodlands. These areas also include wildlife management areas/natural areas designated for the protection of wild animals, within which hunting and fishing are either prohibited or strictly controlled. Identification of environmentally sensitive areas in any community can assist the community protect these important resources.

CLIMATE/METEOROLOGICAL

The climate of a region has a direct influence on the type and abundance of natural resources that are found in that region. Production of agriculture products is very dependent on the longevity of the growing season. Wind direction and other meteorological conditions such as heat,

humidity, and barometric pressure dictate potential pollutant levels caused by commercial and industrial sources and automobiles. Weather data provides a community with information that may determine how climate impacts (directly or indirectly) activities within that community and region.

MINERAL RESOURCES

Natural resources include the land, air, water, animal and vegetation but also includes mineral resources that provide raw materials which are utilized in developing our familiar human-modified environment. These resources may be nonrenewable, such as metals (aluminum, ores), product development (phosphate, limestone, sandstone), and fuels (coal, gas, oil) or renewable, such as timber and water. Extraction of mineral resources typically requires the development of large areas of land, which also can cause significant environmental impacts to that land and the surrounding environment. Development of processing plants for refining of these resources also requires significant amount of land. Together, significant land area within the community may be devoted to this type of land use.

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