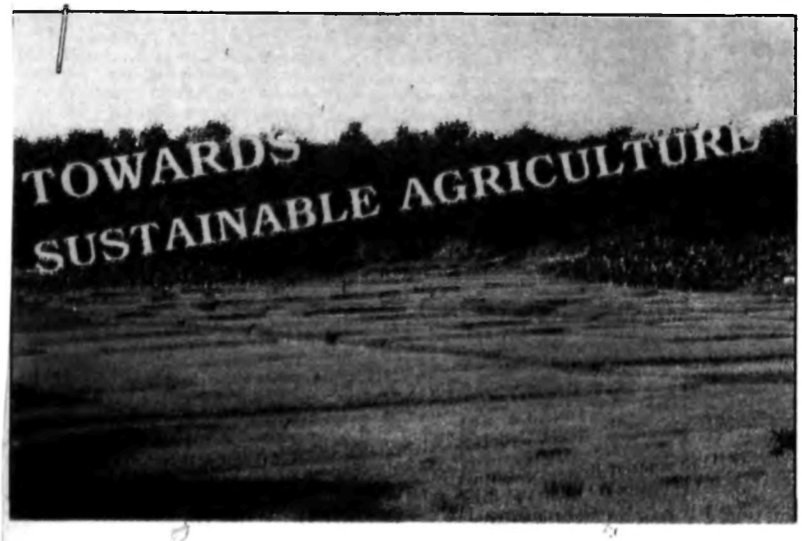

Dr P K Shetty

WHILE agriculture has been practised for the last 10,000 years, massive conversion of natural ecosystems into croplands has occurred during the last 150 years. According to the noted historian John Richards, during this period, 869 million hectares of forest and grassland were converted worldwide to regular cropping. Even though farmers were expanding the area under cultivation, they were not able to provide the required amount of food for the growing population. In the post-war period, farmers adopted modern agricultural practices, as a consequence of which intensity of farming escalated. However, during the past five decades, scientific agriculture has enhanced world food production to remarkably high levels, from 700 million tonnes to approximately 2000 million tonnes per year. India, a land of varied climate and soils, providing a wide diversity in agriculture has also achieved spectacular increase in agricultural production. In 1960-61, the country's grain production was 82 million tonnes, and in 1998-99, it has risen approximately to 200 million tonnes.

The success of modern agriculture while it supported the growing population has posed a threat to the natural environment. The high intensity of farming has adversely affected the quality of land and water. Agro-chemicals

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Towards sustainable agriculture

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On the other hand, erosion will bring down the water quality and also the life of reservoirs by progressive accumulaltion of silt over the years. Simple practices like planting of hedges or rows of trees perpendicular to the direction of wind reduce erosion considerably. Further, planting of cover crops during slack season or leaving the stubble in the fields following harvests will improve the soil stability and moisture retaining capacity. Farming practices across slopes, such as contour bunding and bench terraces will also enhance soil and water conservation.

Conversion of natural or semi-natural vegetation into croplands may have resulted in decline in biodiversity of the agro-ecosystem. Further, adoption of monoculture by the farmers, and the use of high yielding varieties in place of traditional varieties have also led to significant loss of genetic diversity. Extinction of plant and animal species is a part of evolution but today due to human interference, the extinction rate is much higher than the natural rate. According to Peter Raven, a well known botanist, in the coming decades there will be a high rate of extinction at an average of 100 species a day. It is notable that 25 percent of the pharmaceuticals used in the United States contain ingredients originally derived from plants. The worldwide sale of palnt-based drug items is now worth nearly US $30,000 million a year.

Salinization is a potential problem in the agro-ecosystem. If farm land becomes too salty, it will not support the crop growth. Every year 1.5 million hectares of cropland are being lost worldwide to salinization or water logging. Fertile land suffers from salinization either by improper leaching of salts or inundation by sea water. India has approximately 7.5 million hectares of salt-affected soils and atleast 20 percent of irrigated land suffers from high salt content. One of the ways to reclaim the salt affected land is by the process of desalinization but rigation channels, proper drainage of excess irrigation water to avoid salt accumulation, and intermittent ponding of water to have a better leaching of salts, have been founded to be very effective.

India since ages has been the user of eco-friendly organic manures. Only after independence, the country has gone in for the massive production and use of nitrogenous, phosphatic and potash fertlisers. The new high-yielding crop varieties are most responsive to agro-inputs. There has been meteoric increase in the consumption of fertiliers, from 5 thousand tonnes in 1960-61 to 1263 thousand tonnes in 1995-96. Since the 1960's there has been a mounting concern about increased nitrate concentration in farm lands, especially the

high level of nitrate in river and ground water. The health risk from nitrate is often due to converted compounds such as nitrite or nitrosamine. If drinking water contains an excess of nitrate, it causes a fatal condition known as methaemoglobinaemia in young babies. Apart from this, nitrite is a potential source of caner, through the formation of N-nitrosamine. Nitrate pollution in agro-ecosystem is often accelerated due to the addition of industrial or urban effluents. Continuous addition of plant nutrients through surface run off will increase the nutrient levels of an aquatic system. Nutrient enrochment of a fresh water lake or stream leads to rapid growth of algae and deoxygenation. Due to increased dependence on synthetic fertilisers, the production and use of traditional manures has been neglected. It is essential to strengthen this low investment oriented sector because the country has friendly manures and this will help to promote local employment.

In the early 1960's, Rachel Carson's famous book 'Silent Spring' exposed the catastrophic impact of pesticides on a fragile environment. Since then, an enormous amount of research has been conducted which has shown the presence of pesticides and its degradative products in soil, air, water and on living systems. It is estimated that approximately 50 lakh tonnes of pesticides are used worldwide annually. Non-judicious and indiscriminate application of chemicals have contaminated the ecosystem and they have also entered the food chain. Since 1993 there have been about 100 accidental outbreaks of acute pesticide poisoning incidents in the world, many of them related to contamination of food or water, and occupational exposure. It is true that pesticides have become an essential part of modern agriculture and have played a significant role in increased food production. However, excessive pesticide use has not completely eliminated crop pests, and still many countries in the world continue to suffer from crop losses. For example, in the United States about 37 percent of food and fiber crops are lost each year due to pests and diseases. The loss of agricultural produce to pests and diseases in India amount to some Rs 33,660 crores a year.

As the threat to the environment from toxic chemicals continues, there is need for increased public awareness of the facts about these chemicals. Governments should regulate the use of the banned pesticides, and should encourage environmentally safer pesticides. It is extremely important to educate farmers on need-based and judicious use of toxic chemicals. Today, the Indian farmers have to provide food for 1000 million people and fodder for over 400 million livestock. Apart from this, fuel wood is a source of energy for a large population. In future, a sustainable farming system needs to be created through a proper mix of both non-conventional agricultural practices and modern technologies which are environmentally safe and profitable, for producing more food, fodder and fuel wood through the optimum use of the land and water resources.

The author is at the Environmental

have become a new source of pollution and also increased food and livestock production has attracted many entrepreneurs into agro-based industries. Today the agro-ecosystem has to bear the burden of enormous amounts of industrial and agricultural waste products. It is very important, therefore to protect cropland and its soil and water resources for meeting the most basic needs of human kind. There are several issues that need to be looked into in the context of sustainable agriculture, for instance, erosion of natural soil, decline in biodiversity, salinization and agrochemical pollution.

The erosion of the soil is natural and extremely slow process and it has been accelerated by massive deforestation, soil tillage and over-grazing. The formation of an inch of top soil requires a minimum of 1000 years, depending on the climate, nature of parent soil materials and other factors. Top soil is more suitable for agriculture because it is rich in humus and plant nutrients. Each year about 7 million hecatres of cropland are being lost through soil erosion particularly in dry tropical environment. According to Lester Brown, World Watch Institute, every year approximately 24,000 million tonnes of top soil are being eroded globally.

In India, it is estimated that between 11-26 percent of agricultural production is lost as a result of soil erosion. The annual soil loss is accounted at about 6000 million tonnes and it carries away 6 million tonnes of plant nutrients.

The croplands which have lost the natural source of plant nutrients cannot be restored only through the synthetic fertilisers. Besides, micro-organisms are known to play a significant role in ecological cycles particularly in the degradation of toxic chemicals. As a result of erosion this ecological process may be disturbed and many undergraded and partially degraded chemcials will poison the ecosystem.

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