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Agronomic Strategies for Eco- Friendly Sustainable Agricultural Development

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Abstract

Agriculture is the most important enterprise in the world. Green Revolution technologies have more than doubled the yield potential of wheat and rice, especially in Asia. These high input production systems requiring massive quantities of fertilizers, pesticides, irrigation and machines, however disregard the ecological integrity of land, forest and water resources, endanger the flora and fauna and cannot be sustained over generations. To a great extent, future food security and economic independence of developing countries would depend on improving the productivity of biphysical resources through the application of sustainable production methods, by improving tolerance of crops of adverse environmental conditions and by reducing crop and post-harvest loses caused by paste and diseases. Agricultural practices can play a key role in the design of sustainable and eco-friendly agricultural systems, increasing the likelihood that rural population will accept, develop and maintain innovations and interventions. In this context, those eco-friendly systems are being considered environmentally safe, selective, economical and renewal alternative for use in farming system. Most nation economies are based heavily on agriculture, the significant role of agriculture as an engine of economic growth is particularly emphasized.

Introduction

According to Pandit Nehru**,** "Everything else can wait, but not agriculture". This is even true today. On the beginning of new millennium, the challenge before us is to sustain food security and have some surplus for exports to take advantage of the wind of globalization, keeping in view of environmental conservation and conservation of natural resources. Towards the end of sixties, the government adopted the agricultural strategy "Green Revolution", i.e. the period from 1967 to 1978. Green Revolution in India ushered the use of hybrid seeds that were particularly responsive to chemical fertilizers. The Green Revolution I of 1967-68 was the result of introduction of new high yielding varieties of Mexican wheat and dwarf rice varieties. The Green Revolution II of 1983-84, stressed on the expansion in input supplies to the farmers and water management, Mexico, improved varieties of wheat dramatically increased yields because they were more responsive to controlled irrigation and chemical fertilizer. The benefits of green revolution remained largely confined to the North and Northwest parts of the country.

The eighties saw the effect of green revolution waning, with problem of stagnation, decline of yields on irrigated land, water-logging, increased soil salinity rapid rate of land degradation, contamination and over-exploitation of groundwater resources resulting in drought. Extensive use of chemical inputs has polluted surface water and groundwater, causing environmental and health hazards. Use of pesticides generates new breed of resistant pests. Green Revolution basically focused on production, but widened the regional imbalances. Even Seed Companies have given a wrong impression around the world that hybrids are more productive. Increased productivity means more money for the farmers. It seemed like a miracle. But the miracle was short-lived. It didn't take too long for the farmers to discover that in order to reap the promised harvests, large amounts of chemical fertilizer were required. Most of the hybrids were ill-suited to their new growing environments which resulted in unhealthy, less nutrient plants that had pest and disease problems. These called for expensive chemical pesticides. But this was not the concern of the chemical companies who were making big profits. The new hybrids were progressively replacing all the traditional varieties. The older varieties were not saved in case they might be needed in the future--they were eastern. The chemical companies (who own most of the big seed companies) were gaining market control of the seed supply. Because most of the farmers were now growing hybrid varieties, they could not have their own seed for replanting the next. They came back to the Seed Company each year for a new supply. The seed companies dubbed this. "The Green Revolution". The only green thing about it was the greenbacks that went into their pockets. So need is to go for non-hybrid natural one, which would be more fruitful in the long-run.

The Green Revolution cannot therefore be considered to be a 100 per cent success. With recognition of "Green Revolution Fatigue" the time has reached to take serious actions to decrease the ill-effects of green revolution. Simultaneous efforts need to be made to promote a more sustainable form of agricultural and identify sources for future spurt in agricultural productivity

Towards Sustainable Agriculture

In the context of agriculture, "sustainability" refers to the capacity to remain productive while maintaining the resource base. According to Gips 1986, "Agriculture is sustainable if it is ecologically sound, economically viable, socially just, humane and adaptable". Sustainable agriculture is being represented by farming systems in which the use of purchased chemical-based inputs is significantly decreased in comparison to conventional agricultural systems; soil erosion is controlled and weeds managed. There is maximum efficiency of on-farm and purchased inputs, maintenance of soil fertility by proper addition of plant nutrients, and the basic utilisation of biological principles throughout the farming operation.

An Indian agricultural expert has called for an "Evergreen Revolution" in growing food crops that would combine science, economics, and sociology to boost production in a way that can be maintained for decades to come. It is rather an integrated and complete approach. It cannot be restricted to any single crop or to a few states. Instead it will cover almost all major crops of India or all agro-climatic zones of India. Green Revolution was mainly due to high yielding varieties, fertilizers and irrigation facilities, whereas evergreen Revolution would be contributed by integration of several factors like Soil Management, Water Management, Integrated Weed Management, Integrated Pest Management, Integrated Nutrient Management, Tissue Culture, Genetic Engineering, etc.

Plant Tissue Culture can be used as commercial tool for growing Orchid in Kerala. The programme was aimed at housewives. Interest was generated through articles on floriculture in a leading women's magazine. Tissue Culture, planting material and other inputs was provided at reasonable costs. Technical know-how was imparted through regular training programmes and workshops. Marketing assistance was provided. Over a thousand housewives have benefited from this programme.

Crop Rotation is a planned sequence of growing different annual or perennial crops in the same field. Rotations are the opposite of continuous cropping, which is growing the same crop in the same field year after year. Crop rotations can be used to improve or maintain good physical, chemical, and biological conditions of the soil. Rotation also reduces fertilizer needs. Crop rotation can be an important part of an integrated pest management, i.e. pesticide costs may be reduced by naturally breaking the cycles of weeds, insects and diseases. Grass and legumes in a rotation protect water quality by preventing excess nutrients or chemicals from entering water supplies. They can be used to reduce the average rate of erosion from a field. Including a grass or legume in a rotation can be very effective for reducing soil erosion and eliminate the need of fertilizer. Leguminous plants (like peas) have bacteria living in nodules on their roots, which are able to fix the nitrogen from the soil, so that it may be released later for the next crop. Catch Cropping is one of its tools, which is used for filling gaps. Sometimes one crop comes to an end a couple of months before your next begins on the same spot of ground. Suitable crops for filling such gaps include spring onion, radish and lettuce.

Growing small crops in the spaces alongside larger plants, or alongside plants, which are so slow, growing that before they reach maturity the smaller crop has been harvested. Some plants (such as spinach) may be grown this way because they benefit from the shade given by the larger crop. Suitable varieties for intercropping include radish, lettuce, etc.

Rainfed agriculture, or 'Dryland farming', sustains 67% of the arable land area in India. They are called 'Grey' because they are dry most of the year and lack a sufficient amount of fundamental input that is so essential for agriculture. Unreliable rainfall distribution is the leading factor inhibiting the development of rainfed agriculture. This erratic rainfall is also the primary cause of droughts and floods in India. In addition, soils in these regions are degraded and have poor fertility, and farmers are resource- poor with small, scattered, marginal holdings. Efficient rain water management and integrated nutrient supply systems would be needed in rainfed areas.

To make India food secure nation, it is necessary either to bring more area under cultivation or increase productivity of existing agriculture. Land is shrinking day- by-day because of increasing pressure of urbanization and industrialization Therefore, the need is to increase the productivity of existing agriculture and minimize the use of water. Optimum fertilizers with another input play an important role in maximizing the agricultural production.

The best answer to the challenge is "Fertigation", whereby both water and fertilizers are delivered to crops simultaneously through the irrigation system. Fertigation ensures that essential nutrients are supplied precisely at the area of most intensive root activity. Fertigation involves specialized irrigation techniques such as micro-irrigation enabling the application of water by means of drippers, micro- sprinklers and micro-sprayers. This combines the benefits of drip irrigation and efficient fertilizer application for increasing the productivity.

Well-balanced fertigation results in: Nutrient availability to the plant is improved; Nutrient uptake efficiency is increased; and Fertilizer application rates and water requirements are reduced.

Now there is a need to cut down chemical fertilizers and pesticides and improve resistance of crop from various diseases. This will end up NO-NO in international market. Probiotic fertilizers are a complete substitute since they are composed of agricultural wastes, animal manure and local soil. The fertilizer nourishes the microbes in the top soils and the plant root zones which in turn nourish the plant, based on the theory of indirect nutrition. Gujarat is happy to have shifted from chemical to probiotic fertilizers. To protect the plants, farmers usually spray a mixture of buttermilk, old millet flour animal manure which is kept in an earthen pot which is immersed in a pile of dung for fortnight fermentation. This spray stimulates resistance and boosts up immunity in plants.

Biofertilizers a solution for Green Millennium. Biofertilizers are derived from various nitrogen-fixing and phosphate solubalising micro-organisms. These organisms are found in soil, water and leaves surface. A farmer has to be educated or trained in farm production of biofertilizers like Azolla and blue green algae.

Azotobacter was one of these nitrogen-fixing organisms and was till then being used as a soil inoculates or for seed treatment. On dry weight basis, azolla contains 13- 30 per cent crude protein in addition to 4.4-6.3 per cent crude fat. It is also rich in potassium phosphorus, calcium, magnesium and sulphur.

BGA forms scum likes greenish biomass on the surface of water during rainy season in ponds and flooded rice fields. The BGA fix atmospheric nitrogen from the atmosphere in their heterocyst and provide it to the soil either by exosmosis (or) on the death and decay of their living biomass. Besides fixing nitrogen, these algae excrete Vitamin B12, ascorbic acid and auxins, which may also improve the growth of rice plants. There are also convincing reports that BGA possess the properties of solubilizing the bound phosphate of the soil.

Vermicomposting is garbage disposal at its best because recycling is done on- site. It contributes not only to water conservation, energy conservation and soil preservation but helps one get closer to a zero waste goal. Vermiculture is the process by which organic material is fed to a variety of worm species with the purpose of converting the organic material into increased worm biomass and vermicast. Vermicast is the excreta from worms which is biogenic fertilizer. This help in plant growth and is soil conditioner. The worm biomass has been sold for bait, animal feed and acts as small composting systems. It is important from the point of view of abatement of pollution hazards created by large amount of organic waste in our country and increases soil fertility level.

Information technology will also have a huge impact is helping farmers adapt their crops and management to their environment allowing farmers to get vital information about weather, disease and pest epidemics, input and market prices, crop management advice, and many other things. The availability of direct web-site link to different agricultural institutions in India that can be exploited by farmers and public extension system for information dissemination.

Today we have amazing tools of biotechnology and information technology to achieve sustainable development in agriculture - A commitment to Science with a Human Face. So, what we need is marriage between traditional and modern approach that will ensure food and nutritional security resulting for sustainable development.

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