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Original Article

Sustainable Development of Agriculture through Traditional Methods and Modern Technology

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Abstract

Indian agriculture is currently suffering from various problems. Due to increasing expectations of production and the use of various types of chemicals for this, the fertility of the land is being destroyed. Growing crops without using soil testing facilities, ignorance about agriculture and the environment are creating new crises. Insufficient knowledge of humans and crops while using various types of chemicals is causing damage to health. Excessive use of pesticides, insecticides and chemical fertilizers in the soil is destroying the fertility of the land. Currently, biotechnology and artificial intelligence are being developed everywhere in India, if this knowledge is converted into farming methods, it will definitely be beneficial. Currently, the need for sustainable technology is in agriculture, which we can use properly to give a new direction to the agricultural industry. Although traditional crops produce less yield compared to today's modern crops, they do not harm humans, animals and the environment. Today's farmers are educated, and they are also handling technology to a certain extent, for this they need proper training.

By going to the village level with the concept of 'Small is Beautiful', we can give the right direction to agriculture and the farming community through awareness. From my perspective, this is an important option to establish a sustainable economy. Only through this can we achieve sustainable development.

For this, there is a need for an organization, as per the statistics of 2024, there are currently 8875 farmer producer companies in India. They mainly work on agriculture, farmers and facilities. Along with this, if we instill values to implement various government schemes regarding organic farming, then the goal of sustainable development can definitely be achieved.

Keywords: *Indian agriculture, sustainable technology, artificial intelligence, organic farming.*

Introduction

Modernity and the constant pursuit of innovation have made human life dynamic. The revolutionary discovery of science has changed human civilization and culture. It has affected all aspects of human life. We are using more and more tools to fulfill our material needs. Various trade routes are found in India from various documents of ancient and medieval times. Also, due to the fertile land, various crops were grown through agriculture. These fruits were in demand all over the world. Earlier, when there was a lack of services and facilities and tools, a self-sufficient economy had developed in the village. Agriculture was the main source of the economy. All the needs of the village were met through agricultural produce. Among the crops, various types of pulses, cereals, and vegetables were grown by everyone. There were bullocks, plows and wooden tools for farming. That is, the traditional method was followed. Seeds for agriculture were available in the village itself, various types of seeds were sterilized and kept in earthen pots. It was done in almost every family.

The purpose of this is to say that the tools used for agriculture were traditional. Fertilizers were made by rotting cattle excrement, i.e. cow dung or other mulch. As a result, production was good.

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But in the name of agricultural development, a system was created in the past few years, farmers were deceived by the desire of modernity and big companies for high production. As a result, farmers used to use fertilizers, pesticides, and herbicides excessively in agriculture. Initially, production increased, but due to excessive use of chemicals, the bacteria that were beneficial to the crops died. The fertility of the soil was being destroyed. Climate change also affected the agricultural economy. In the past, there were droughts, but their effects were not felt on the agricultural economy. Because the use of chemicals was less. The cost was less, so the effectiveness of the drought was not felt. Due to the change in crops, cotton and maize were planted in large quantities. Compared to other crops, cotton and maize require more cultivation and cost for cultivation. Often, double sowing is also required. Even if the product is not available for one year, the cost increases, this change has mainly happened. Small farmers have become agricultural laborers, big farmers have sold their lands. Some have become indebted. The self-sufficient rural way of life has disappeared.

To restore the previous self-sufficient rural life, measures will have to be taken for agriculture in the direction of solutions and sustainable development. For sustainable development, changes in agriculture are now necessary. Traditional crops will have to be given importance, the importance of organic fertilizers will have to be told to the farmers directly, excessive use of chemical fertilizers, pesticides and herbicides will have to be avoided. Agricultural crops will have to be changed. Proper water planning will have to be done. Agriculture-based related businesses will have to be developed, excessive use of machinery will have to be avoided, the mathematics of water and agricultural economy will have to be adjusted. Farmers will have to form a producer company or organization and invite banks to get help. Proper planning will have to be done regarding how many people in the family are dependent on agriculture. The difference between the previous year's agricultural expenditure and the current year's expenditure and production will have to be told to the farmers.

The situation of agriculture and villages is the same in almost every village. If we can see examples of this, let us become aware and go to the villages, let us create a prosperous India. This is the basic mantra of sustainable development.

Some solutions

What are soil testing, importance, process and benefits?

Soil testing is a scientific analysis that evaluates the chemical, physical and biological properties of soil. It provides information about the level of nutrients in the soil, pH balance and amount of organic matter, texture and possible contaminants. It is important for farmers, horticulturists, environmentalists and construction professionals in land use, crop selection, fertilizer use and environmental measures. Optimizing nutrient management, soil testing helps determine the amount of nutrients in the soil, so that farmers can use the correct amount of fertilizer. This avoids over-fertilization, reduces costs and reduces environmental pollution caused by mixing excess nutrients with water bodies. Improving crop production and quality: By identifying nutrient deficiencies or imbalances, soil testing helps increase crop productivity and quality. Adjusting nutrient levels based on test results ensures that plants get the nutrients they need for healthy growth.

Environmental Protection: It helps prevent soil degradation and pollution by identifying potential contaminants such as heavy metals, pesticides or excess salts. It is also important for protecting ecosystems and water resources. Cost-effectiveness: Soil testing helps in cost-effective resource management by optimizing fertilizer use and reducing unnecessary spending on non-essential inputs. Soil Testing Process: (Sampling) In the first stage, it is important to collect soil samples from various locations in the field. Samples are taken at different depths and locations, taking into account differences in soil texture, land use and topography. Analysis: Soil samples are tested in various laboratories. These include pH testing to measure acidity or alkalinity, nutrient analysis (nitrogen, phosphorus, potassium, etc.), organic matter assessment, soil texture analysis (and (soil, silt, clay) and potentially other tests based on specific requirements (heavy metal analysis, salinity, etc.). Sustainable Land Use: By understanding soil health, landowners can adopt sustainable practices that preserve soil fertility and health for future generations. Improved Plant Health: Balanced nutrient levels support healthy plants, improving resistance to diseases and pests. Environmental Conservation: Proper soil management based on test results helps conserve water resources and reduces the risk of soil erosion and runoff, thereby preserving the surrounding environment. Conclusion: Soil testing is a fundamental tool for sustainable land management, agriculture, and environmental conservation. By providing important insights into soil composition and health, it enables landowners, farmers, and environmentalists to make informed decisions that

increase productivity while conserving natural resources. Regular use of soil testing is an important step toward sustainable farming.

Uses of Herbicides:

During farming, various types of weeds grow in the soil and crops, and today a large amount of herbicides are sprayed to control these weeds. Herbicides destroy beneficial microorganisms in the soil, which deteriorates the soil texture and disrupts the nutrient cycle, resulting in reduced soil fertility. Residues of these chemicals remain in the soil, which reduce soil quality and harm the environment. In addition, herbicides mix with groundwater and pollute water, which negatively affects human health and the ecosystem. Destruction of microorganisms: Herbicides kill various beneficial microorganisms in the soil, which are important for soil fertility and nutrient formation. Minimizing the use of herbicides and adopting alternative methods such as organic farming are important for soil health and environmental protection. Soil texture deteriorates: The lack of microorganisms deteriorates the natural texture of the soil, which reduces water and air transport. Disruption of nutrient cycling: Herbicides reduce the decomposition of organic matter in the soil, which stops the cycling of nitrogen, phosphorus and other nutrients. Loss of soil fertility: Long-term use of herbicides reduces soil fertility and makes the nutrients necessary for crop growth unavailable. Chemical residues: Herbicide particles remain in the soil for a long time, which contaminates the soil and also negatively affects the growth of subsequent crops. Water pollution: Herbicides leach through the soil and mix with groundwater, which contaminates drinking water sources and also affects aquatic life. Impact on biodiversity: The use of herbicides reduces the biodiversity in the soil, which affects the overall functioning of the soil.

Uses of Chemical fertilizers:

Today, chemical fertilizers are used on a large scale. How can a living crop be fed with fertilizer made from things like petrol? These chemical fertilizers are processed by bacteria in the soil to feed the crop and make it edible. Today, we have to use at least 2-3 bags to get the results that we got by applying one bag of chemical fertilizer 20-30 years ago. Why is this? The reason is that earlier, the number of bacteria in our soil was high because of the organic matter we used. Earlier, we used to have a lot of cows and buffaloes at home and their dung was collected and stored, the ashes from the stove in the house were thrown in the field, and if an animal in the house died, it was buried in the field. Due to all this, the number of bacteria in the soil was high. This is what we used to say that the soil is alive. Now, we have gradually reduced the amount of organic fertilizers, some have even stopped using organic fertilizers completely. Due to this, the number of bacteria in the soil has decreased and the response to chemical fertilizers has decreased. Organic fertilizers contain a large number of bacteria. These bacteria combine the chemical nutrients given in the soil and feed the crop. Due to this, unused chemical fertilizers are used.

46:00:00 is written on the bag of urea. This means that this bag contains 46% nitrogen; phosphorus and potassium are 0%. That is, a 50 kg bag contains 23 kg of nitrogen. After adding this urea, about 12-14 kg of urea is used immediately and the remaining urea is wasted due to lack of sufficient bacteria in the soil and cannot be used by the crop. In the first 7 days, the crop grows vigorously and then there is a doubt whether the growth is stunted. Due to this, we use expensive micronutrients. The truth is that since the added fertilizer is not completely used, we think that the growth of the crop is stunted. But along with this, if organic fertilizer is used, chemical fertilizer feeds the crop in the right amount and for a long time. Since our fertilizer contains its own nitrogen, phosphorus and potassium, the crop gets fed in more quantity than usual, due to which there is a significant increase in growth and production. There is no alternative but organic, biological, organic to increase the number of bacteria in the soil.

Organic farming technology prohibits the use of chemical inputs (chemical fertilizers, pesticides, fungicides, herbicides, biocides, soluble fertilizers, etc.) and in this farming system, crop management is done through organic fertilizers, green manures, crop rotation, mixed cropping system, biological pest and disease control, etc.

It generally takes 4-6 years to completely convert a conventional farming system to an organic farming system. The first 3 years of this In this way, the farmer can sell his produce in the local market under the name of organic produce and after converting to a complete organic farming system in about 4-6 years, after obtaining a certificate through an organic certification system, it can be sold in the country and abroad under the name of organic certified produce. For this, it is mandatory to certify organic farming through the systems designated by the Government of India.

While starting organic farming, it is advisable to cultivate forestation on one-third of the total area to be brought under organic farming. In this, trees that preserve biodiversity like Subabhul, Giripushpa, Shevari, Shevga, Hadga, Apta, Bor, Mango, Neem,

Sitafal and Bamboo have to be planted. Cash crops have to be cultivated on one-third of the area and food crops have to be cultivated on the remaining one-third of the area. Through this, it is possible to create a suitable environment for adopting organic farming through biodiversity in conventional agriculture. Because living soil is the center point of organic farming and to achieve this center point of living soil, it is a matter of sequence to increase the amount of organic carbon in the soil to 2 percent. Organic fertilizer is called the energy source of the soil. For this, the farmer will have to take care that all types of waste materials in the field do not go outside the field. The farmer can easily process all the wood waste, straw, crop residues, straw, weeded grass, waste components of crop production, etc. in the field itself and produce organic compost or organic materials from it. In organic farming, the organic matter content of the soil can definitely be increased to 2%, and through this, the water retention capacity of the soil, the ability of the soil to drain excess rainwater and moisture, soil fertility, the ability of the soil to maintain constant moisture conditions, and the number of useful biological elements in the soil are improved.

Like organic farming, farming methods such as eco farming, eco friendly farming, ecological farming, natural farming, biological farming, biodynamic farming, biointensive farming, conservative farming, no tillage farming, zero tillage farming, minimum tillage farming, permaculture, permanent agriculture, regenerative agriculture, indigenous agriculture, alternative agriculture also exist in various places in the country and abroad. In organic farming, crop management can be done through organic inputs, biological inputs, plant inputs, etc., through seed treatment, nutrient management, pest and disease management. However, for this, the quality and standard availability of these inputs are very important. At present, it is found that the quality and availability of the inputs used in organic farming are detrimental to the development of organic farming. In organic farming, nutrients, pests and diseases can be managed mainly through organic and biological inputs.

Agri-economy and sustainability from Gandhi's concept:

Gandhi suggested solutions to all the factors based on agriculture in agri-economy and sustainability. This included farming methods, people, seeds, fertilizers, environment, animals, institutions, etc. Gandhi believed that a farmer should have enough land that his family members can cultivate. He should have enough land to grow crops, support his cattle with their produce, and also to maintain biodiversity and regenerate himself. In other words, he wanted the farmer to treat the earth as his mother. Gandhi said that the farmer should have enough land on which he can earn his daily income honestly and live a life with dignity. Organic farming should be used with importance. One should try to return as much as is taken from the soil. The things used in agriculture should be labor-intensive, suitable and environmentally friendly. The tools and implements used should be made locally. The source of energy should be decentralized and local. The farmer should have enough cultivable land that will give him a complete and reliable means of livelihood. Farmers can come together and form cooperatives or communities to cultivate their land. No one group should dominate these areas. Gandhi believed that all efforts should originate from society and should be completely voluntary.

The direction and speed achieved by economic progress today is frightening. The idea of 'small is beautiful' has been forgotten. The desire for big things has increased. Big factories, big farms, big markets, big malls, big industrial estates and big industrial houses are seen coming to the fore today. There is no place for man in this narrow, selfish-minded economic progress. This progress has no human face. Only the prosperity of material resources. For whom are these resources? Are people truly happy with these resources? This question has been lost somewhere in the desire for progress. Gandhiji's agricultural economy ultimately leads to village self-reliance and village swaraj. All the problems created by the capitalist economy can be solved This has its power. By creating employment in the villages, the migration to the cities will stop. The problems of slums will be solved, inequality will be curbed. The pressure on the transport system will be reduced. The overall economy will get a human face.

We will have to find the reasons behind all these changes and move towards solutions to restore the previous self-sufficient rural life, through which measures will have to be taken for agriculture in terms of sustainable development. For sustainable development, it is now necessary to make changes in agriculture. We will have to give importance to traditional crops, we will have to tell farmers the importance of organic fertilizers directly, we will have to avoid excessive use of chemical fertilizers, pesticides and herbicides. We will have to change agricultural crops. We will have to plan properly for water. We will have to develop agriculture-based related businesses, we will have to avoid excessive use of machinery and we will have to balance the mathematics of water and

agriculture economy. We will have to form a farmer producer company or organization and invite banks to seek help. We will have to plan properly for how many people in the family are dependent on agriculture. The farmers will have to be informed about the difference between the previous year's farm expenditure and the current year's expenditure and production.

Government Policies:

To reduce the use of chemical fertilizers and promote organic farming, the government is implementing initiatives like 'Pradhan Mantri Bhumate Restoration, Awareness, Nutrition and Improvement' (PM-PRANAM). Under this, emphasis is being placed on increasing the use of nano urea, nano DAP and organic fertilizers. With an emphasis on reducing the use of chemical fertilizers, the Economic Survey has mentioned that the 'Pradhan Mantri Bhumate Restoration, Awareness, Nutrition and Improvement' (PM-PRANAM) initiative encourages states to reduce the use of chemical fertilizers. It also encourages the use of alternative fertilizers, such as nano urea, nano DAP and sustainable methods like organic fertilizers.

Focusing on the security of farmers' crops, the Economic Survey has introduced the Pradhan Mantri Fasal Bima Yojana, which provides protection against crop loss due to natural calamities, pests or diseases and ensures financial stability for farmers. The scheme protects the livelihood of farmers and encourages them to adopt modern farming methods and technologies.

Maharashtra's agriculture sector is now using new technologies to increase farmers' income, reduce production costs and meet challenges like climate change. The state government's "Maha-Agri-AI Policy 2025-29" is focusing on the following technologies for sustainable, resilient and productive agriculture. Artificial Intelligence (AI), Generative AI: Personal advice for farms, Internet of Things (IOT): Smart farm monitoring, Drone technology: Aerial assistant for farms, Computer vision: Eyes of the farm, Robotics: Automated assistant in the farm, Predictive Analytics: Future prediction, Edge computing: Instant decisions, Satellite observation of farms, Block chain technology: Secure transactions, QR code traceability: Product story, Digital Public Infrastructure (DPI): Power of data, 24-hour advice, Simulation Tunes: Virtual farming, Innovation laboratory, Rapid testing, AI-based traceability and supply chain tracking, VISTAAR project: Empowered advisor for farmers, through which various solutions are being implemented directly for agriculture and farmers.

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