

GREEN TECHNOLOGY IN AGRICULTURE: TOOLS AND TECHNOLOGIES THAT DRIVE SUSTAINABLE INDIAN AGRICULTURAL DEVELOPMENT

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Agriculture plays a meticulous role in ensuring long-term sustainability for the development of agriculture and its allied field. Agriculture generates food and is reliant on natural resources to do the proper development of the agriculture sector. Moving toward a more sustainable route of economic development necessitates excellent stewardship in agricultural production, since both food and natural capital are required for current and future generations. During the food production is was the fact that the agriculture is one of the most significant contributors to environmental degradation

now a day in terms of food production, storage, transportation up to its resulting in massive volumes of fossil fuels being released into the atmosphere which hastening global warming. With the world's population growing and living standards rising, it's more critical than ever to focus on the greatest green agricultural technologies available.

The United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM) stated that the sustainable agriculture development for the eradication of poverty by guaranteeing environmental sustainability. Such agro-based environment-friendly technology is termed as "Green Technology (GT)". Green technology, sometimes also known as clean technology, aims to lessen humans' negative effects on the

environment, and when properly implemented, can support the human population on Earth indefinitely while also providing future generations with effective agricultural systems to use for the higher production rate.

Green agricultural technologies are significantly important as its preventing environmental damage, produce fewer fossil fuel by-products, and aid in long-term agricultural development. The agriculture and its allied sectors having some green technological application range in terms of Renewable energy, zero tillage, biotechnology, organic farming, vertical farming, irrigation, integrated pest management, drones, fleet management, and digital sensors are among the top green technologies and approaches that are helping to make good farming.

RENEWABLE ENERGY AS A GREEN ENERGY:



Renewable energy, often known as clean energy, is critical for agriculture's long-term viability. A renewable resource is a natural resource that can refill itself to replace what has been consumed; it cannot be depleted, making it a sustainable resource. Currently, the majority of agricultural machinery is powered by fossil fuels, which emits greenhouse gases into the environment and contributes to the hazardous effect on climate change. Using renewable energy sources, this environmental harm could be minimized. Renewable energy as a green technology and sustainable agriculture are an excellent matching part since these natural resources can be gathered together, providing farmers with a steady source of revenue generation with the desired effect. Solar technologies generated the electricity in the form of solar energy in which the solar light radiation convert into electrical energy from

the sun can be used for running farm operated machineries and various food processing equipments, farm lighting and water irrigation pumping as an versatile use for agriculture. Such type of green technology mainly useful for agricultural as well as all agricultural allies sectors. Solar thermal technologies are another green technology which is becoming more favored. It converts solar heat radiation into heat energy and can be used to heat water, solar greenhouses etc. Wind turbines are a popular choice for farmers because they don't use up much land. They can be used to pump water for irrigation. Biomass is made up of living things like maize, plants, and animal excrement. After that, the substance is burned to produce energy. The heat can be used to heat buildings, dry crops, and run dairy operations directly. It can also be used to generate power and steam.

ZERO TILLAGE PRACTICES VIA GREEN TECHNOLOGY:



Zero tillage, often known as no-till farming, is a form of farming that does not need ploughing the land or the use of heavy farm machineries as the soil is not disturbed as much as it is with traditional farming practices carried out from the accident time, greenhouse gas emissions are minimized with reducing the erosion and runoff. Zero tillage also promotes soil carbon sequestration (the amount of carbon absorbed and stored by the soil) and makes use of crop residue left on the soil surface from previous crops. Overall, this environmentally friendly farming practise reduces the quantity of greenhouse gases released into the atmosphere while also saving farmers money. This strategy

has demonstrated to be beneficial to both the environment and the economy, and it is essential since it can be used anywhere in the world. Zero tillage does not necessitate a large financial investment before seeing returns. Educating farmers about this method could be a huge step toward ensuring the agriculture industry's long-term viability. No-till farming is a sustainable strategy that also considers the enormous global food need. This method was first developed with the goal of conserving water and soil, but the added benefits of lowering greenhouse gas emissions could be beneficial to the globe.

GENETICALLY MODIFIED ORGANISMS (GMO) EFFECT ON GREEN TECHNOLOGY:



A genetically modified organism (GMO) sometimes known as Biotechnology is the act of altering a crop's DNA in ways that do not occur naturally. The ability to create plants with precise traits is a powerful technology that has many benefits for humans, including aiding in the fight against climate change. Biotech crops are more environmentally friendly. By adopting genetically modified stress tolerant and high producing crops, biotechnology helps to mitigate the consequences of climate change.

GMOs can also be produced in such a way that they require fewer pesticides and are less often ploughed. This links to zero tillage – biotechnology also benefits from all of the points in the preceding section. Biotechnology is currently viewed as a viable option for addressing climate change, and these genetically modified crops have already demonstrated a reduction in greenhouse gas emissions when compared to conventional crops.

ORGANIC FARMING TECHNOLOGICAL PRACTICES:



Organic farming is the practice of improving soil and human health while also conserving the environment via the use of environmentally friendly farming methods. It employs higher-quality soils, resulting in improved agricultural productivity and, as a result, a more cost-effective solution. Organic farming requires fewer fertilisers and insecticides, both of which use a lot of fossil fuels to manufacture. Crop rotations and manure are used instead to control pests, weeds, and disease. By sequestering carbon into the soil, organic green technology helps to alleviate the consequences of global warming. Organic farming must be done in a balanced manner because it requires less energy and encourages higher biodiversity. To produce the same products, organic farms often require significantly bigger land areas than industrial farms. Most likely, if everyone switched to organic farming, we'd have to start chopping down forests to accommodate it.

THE CONCEPT OF VERTICAL GREEN FARMING:

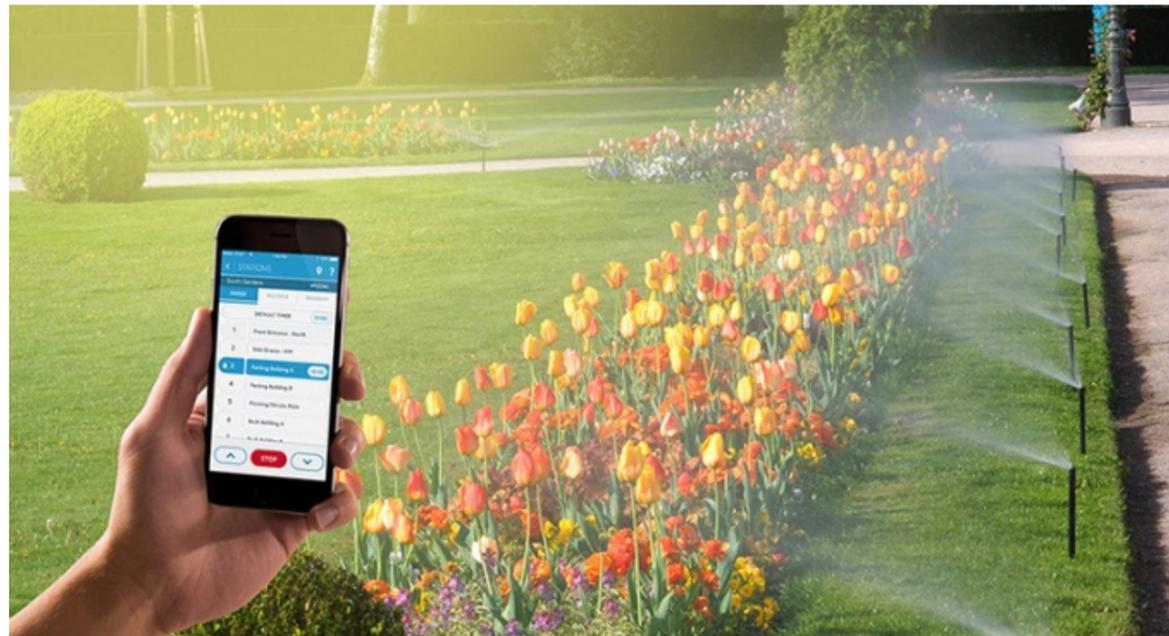
Vertical farming, as opposed to traditional horizontal farming, is the process of growing crops in vertically stacked layers. Farmers will be able to grow significantly more food on the same amount of land as before. Environmental agriculture and techniques such as aquaponics and hydroponics are frequently used. Vertical farming can be a sustainable urban farming method that benefits the environment, the economy, and society. Farmers will see an increase in yield as well as a reduction in water and fertiliser waste. This new technology has been found to reduce water consumption by up to 95%. Because the crops are grown in a controlled climate, pesticides are used less frequently to combat pests and diseases. Another significant advantage is that vertical farms may be developed anywhere, including in urban and densely populated regions, to meet local food demands.



Local crop cultivation and harvesting reduces the quantity of 'food miles,' which lowers travel expenses and reduces carbon footprint. In metropolitan regions and countries with limited free land, this green technology is preferred.

IRRIGATION MONITORING PRACTICES:

Irrigation is the act of providing water to crops, and it is an important aspect of the agricultural process. Without enough water, the crop would not produce a healthy yield. With the right equipment, however, you can ensure that you are using the water supply as wisely and efficiently as possible. The less water a farmer consumes, the more environmentally friendly his or her activity becomes. The Earth's water supply is finite, which means we only have so much, and conserving water is critical to maintaining environmental health. Wireless and remote monitoring technologies are now available, allowing farmers to acquire a better understanding of their operations and make more informed decisions about their operations.



INTEGRATED PEST MANAGEMENT (IPM) SYSTEM:

Integrated Pest Management (IPM) is a modern, sustainable approach that encourages the use of natural pest control mechanisms in order to grow healthy crops with as little disruption to ecosystems and risk to the environment as possible. Crop health is critical for agricultural productivity, so IPM is a critical green technology for the future. It reduces the use of synthetic pesticides and the farmland's toxic footprint. It is a green technology that many farmers can afford and that will make their land healthier and more productive.



USE OF DRONES AS A GREEN TECHNOLOGY CONCEPT FOR INCREASING SUSTAINABILITY:

Everyone has noticed the growing fascination and preoccupation with drones. They appear to be used for everything these days, but that could be for a good reason. They've shown to be quite effective in the agricultural industry as a green technology for increasing sustainability and combating climate change. Drones are utilised in precision farming because they eliminate the need for guesswork and help farmers become more efficient, and hence more sustainable, in their work. Many parts of the farming industry can benefit from this innovative and powerful technology. Drones are ideal for obtaining aerial imagery and inspecting crops because of their large array of sensors and cameras. They can also be used to manage livestock, spray crops, and map irrigation systems. Drones are quickly becoming a common smart farming tool, and their prices are anticipated to continue to fall as their usage grows.



AGRICULTURAL BASED SMALL ROBOTIC GREEN TECHNOLOGY:

Robots that work on a farm don't just have to be the flying variety they can also operate on the ground. Many companies are popping up that are designing robots that will not only help farming become more efficient, but also reduce environmental impacts. The small robot company is a great example of how robotics and AI can be used to benefit the environment. Their robots can be deployed on farms for a variety of reasons such as applying pesticides in a targeted way, rather than spraying wildly from a tractor. The fact they don't need to carry a human passenger also means they are much lighter than other farm machinery and so they don't compact the soil as much. Soil compaction is a serious issue in agriculture, resulting in soil runoff, which pollutes waterways and causes flooding.



FLEET MANAGEMENT GREEN TECHNOLOGY:

Looking at automobiles is an important component of making agriculture more sustainable because they contribute significantly to the amount of fossil fuels produced by the industry. Fleet management is a green technology that has improved in recent years thanks to advances in GPS technology. These sophisticated devices can provide extensive information on fuel consumption, engine speed, and scheduled maintenance. At the end of the day, this technology can be utilised to ensure that the equipment is utilised as efficiently as feasible.

Farmers will save money while also reducing their carbon footprint. Due to the fact that this type of technology is not yet available for everyone to use, it is not currently available for everyone to use.



Because of the cost, this type of technology is not currently available to everyone, but it is becoming more common, and the information is being taught to new farmers all the time.

THE ADVANCED DIGITAL SENSOR TECHNOLOGY AS A PART OF GREEN TECHNOLOGY:

Digital Sensors available in the present day can be used to monitor every aspect of Indian farming system and is assisting in making the industry more sustainable with lower environmental impacts and its reducible health hazards. Sensors can track microclimate data, pH levels in soil to check its fertility rate and even animal movement. This is a new technology that is still in its infancy in terms of what it could potentially help us achieve in the



long run. Precise data assists farmers in making informed decisions, ensuring that their production is as sustainable as possible. Farmers can use digital sensors to increase yields, conserve water and fertilizer, reduce waste, and increase productivity. This green technology is becoming more affordable and accessible, and it will be available very soon.

CONCLUSION:

The above mentioned various green technologies will be at the forefront of transforming the agriculture by 2021. The reality is that saving the globe from environmental degradation and deteriorations, it will be require a combination of different green technologies and a return back to more "traditional" approaches such as organic farming with the higher yield in fruits and vegetable production. New beneficial green technology is always being produced, implying that study is being conducted and that farmers are working hard to make our agriculture and earth a more sustainable one. Agriculture will always be necessary for our human population, therefore finding the most effective approach to maintain it green and sustainable.