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Precision Technologies; a tool of increasing agricultural production

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Introduction

Increasing agricultural productivity has always been one of the key concerns for farmers throughout the history of agriculture. What are the best strategies to boost agricultural output per hectare and what are the primary elements influencing crop yield are the main questions on farmers' minds. The importance of this topic has recently increased due to the world's population's steady growth. But when new difficulties for farmers arise, so do new approaches and technological advancements that are needed to address them. What growers can do to increase crop output on their farmlands and how new technology can assist farmers in this regard are the subjects of this article's review.

Crop yield is the measure of seeds or grains which is produced from a given land plot. It is usually expressed in kilograms per hectare or in bushels per hectare. Such an indicator as the average crop yield per hectare serves as the evaluation of a farmer's agricultural output on a particular field over a specified time period. It is said to be the most significant indicator of a farmer's success since it captures all the resources and labour that farmers have put into nurturing the growth of the plants on their farms. Given this, it should come as no surprise that the majority of farmers are constantly seeking ways to "improve the average crop output per hectare".

The key variables that influence crop production and the most effective and modern tools and technology that may assist farmers in increasing yields on their farms are examine in sub sections.

THE WAYS TO INCREASE CROP YIELD.

For centuries, farmers have pondered over and worked on the issue of increasing crop yields. Some of the solutions were effective, while others weren't. Aside from the

invaluable wisdom of earlier generations of farmers, the agriculture sector today can gain from the accomplishments of contemporary science and technology. Let's now examine the primary methods used by farmers to boost crop yields and examine how past expertise and cutting-edge technology can be successfully merged to enhance agricultural workers' performance.

1. Quality of Seeds

Agricultural productivity depends on the quality of seeds with which farmers sow their fields. Therefore, in order to increase crop yield on their farmlands, agrarians are recommended to sow only certified seeds that have passed all the necessary quality controls. Certified seeds may cost higher than those that do not have certification, but the result will be worth it, because the proper quality of seeds is one of the main factors that affect crop yield. Besides that, planting only high-quality seeds represents one of the eco friendly methods to increase crop yield. If needed, a farmer can check the quality of particular seeds by referring to a relevant seed company and requesting it to conduct special trials on a given land plot.

In addition, it's crucial to keep in mind that the quality of seeds is not something that is constant and unalterable. From the moment they are sown in the soil, seed grains require protection. One method for treating seeds to achieve this is seed coating. It is the technique of enclosing seed grains in exterior materials to improve their properties (weight, size), and/or to give them some active substances (micronutrients, microbial inoculants, growth regulators, etc.) in order to protect them from plant diseases and to accelerate their growth.

2. Field Productivity Zoning

Before sowing, it is important for a farmer to understand productivity of the field that is to be sowed and, if applicable, define specific areas where plants grow better. This process is called productivity zoning. In this technique, a farmer can plant seeds more sparingly in low-productivity zones while planting them more densely in high-productivity zones, potentially increasing crop yield. Additionally, such zoning enables farmers to effectively treat the less productive field sections and take all necessary steps to improve the soil's fertility and other crucial qualities for growing particular plants.

Today's technologies allow farmers to carry out such productivity zoning of their fields faster and more efficiently than before. For this purpose many agrarians use the different GIS software's and remote sensing platforms. With high-precision technology and satellite-driven data, the growers can generate field productivity maps based on the historical data and, thus, clearly identify the areas with the highest and the lowest productivity on a given farmland or plot as shown in figure 2.1.

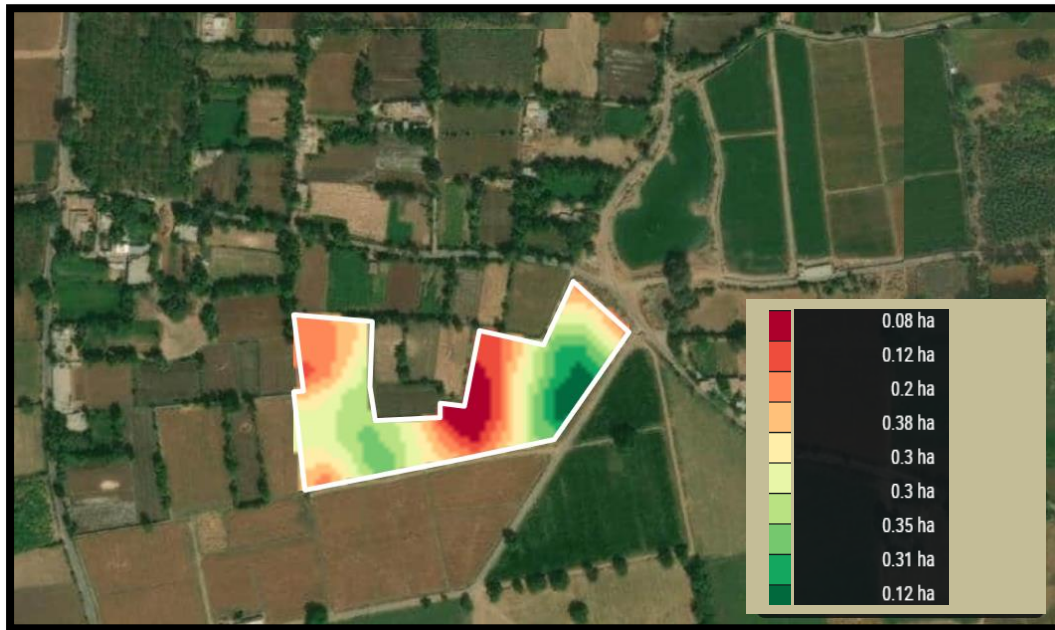


Figure 2.1 shows the field productivity zoning maps of navli field ($22^{\circ}31'11.0''N$ $72^{\circ}57'54.0''E$) of Anand district on date 24th September 2022.

3. Monitoring Crops Growth

Monitoring plant health is crucial from the earliest stages of growth from sowing and right up to harvesting in order to quickly identify any issues that might develop on a specific farmland (such as pest infestations, plant diseases, weeds, etc.) and have an impact on crop yield.

Regular, Spatially and temporal satellite monitoring of land plots, for instance, allows farmers to easily follow the growth status of plants and carry out crop yield estimation using remote sensing as shown in figure 2.2. The evolution of plant health status provides key information to decide on possible interventions to the needs of crops.

Even though satellites do not measure the stages of plant growth directly, but with spectral indices. Satellite-based remote sensing data delivers information on temporal scale, analyses their temporal dynamics, and computes their sum. Based on this information, software may identify different plant species' growth stages and show how those stages relate to other pieces of information so that farmers can make well-balanced decisions.



Figure 2.2 shows the monitoring of growth indices using crop monitoring software's for farmland.

4. Accurate Weather Prediction

The average crop yield per hectare on a given field is very much conditioned by weather factors. With the same quality of soil and the same species of seeds planted, the growth of plants and, in turn, yields is mostly influenced by climatic conditions. This is especially true when taking into account how agriculture is affected by climate change both locally and globally. Farmers have the opportunity to make use of the most recent technical advancements that enable them to receive precise weather forecasts in order to deal effectively and constructively with such an important but uncontrolled component as weather.

The use of crop monitoring software's in precision farming gives a possibility to take preventive measures as to protecting their crop yield from possible damages caused by weather extremes. High-precision weather forecasts can help growers decide what agronomical practices they can perform. Given all this, it is worth noting that accurate weather forecasting in precision farming can greatly contribute to increasing crop yields on a particular farmland. Crop Monitoring gives weather analytics to farmers, including forecasts, historical weather data, and both present and historical weather data. Additionally, remote sensing based software enables to identify extreme weather conditions that may have an impact on crop harvests (*viz*; cold stress, hot stress).

5. Proper Irrigation

Farmers who aim to boost their fields' average crop yield production per hectare must have a well-organized irrigation system on standby. Giving plants the right amount of water immediately affects how they develop and, as a result, how much produce they produce. Weather predictions have a direct impact on how efficiently agricultural land is irrigated. Access to hyper-local weather forecasting is made possible by modern technologies, including software's and specialised programmes for farmers. It opens the way for precise irrigation and enables farmers to organise and plan irrigation of their fields in the most precise and effective way possible.

6. Smart Application of Fertilizers

Fertilizers should only be used in a balanced, responsible manner, even though they are meant to nourish different types of soil, encourage plant development, and raise harvests. When fertilizers are used excessively, they can have a negative impact on the soil's quality and, consequently, the productivity of the crop. The ideal option in this situation is to use fertilizers selectively, based on the requirement for them in different field zones. Varied locations within one field may have different needs for soil fertilisation, therefore using fertilizers selectively is the best approach. The soil is kept healthy thanks to this precise method of field fertilisation, which also contributes to an improvement in the average crop output per hectare.

The crop monitoring software's is one of the technological solutions in this situation. It contains a field zoning tool that, using satellite imagery, divides a farmland into 2-7 zones, highlighting the regions that need more attention than others. Growers frequently employ such precision technology as one of the environmentally friendly ways to boost crop productivity.

CROP PROTECTION METHODS

Farmers who want to boost agricultural yields must tend to their plants from the beginning of their development until the end of the growing season. Farmers employ a variety of compounds to lessen the effect that weeds, pests, or diseases may have on crop yield, depending on the issue that may develop. Typically, these chemicals are adjuvants, fungicides, desiccants, insecticides, herbicides, and insecticides.

In general, there are various crop protection methods. Among the main ones are weed/pest management and plant disease management.

1. Weed and Pest Management

During the growing season, farmers' primary challenges are managing pests and weeds. For instance, a single weed can produce over 10 million weed seeds, and if they are not controlled in a timely manner, they can significantly reduce the yields on a given field and cause issues for years to come. Farmers must also adopt a comprehensive approach to managing pest problems. Farmers must always be ready to respond to the pest infestation issue in a timely manner because pests are highly adaptable and quickly reproducing organisms that might threaten the produce on a specific farmland.

2. Plant Disease Prevention and Management

Another important threat to a grower's agricultural output is represented by plant diseases. Depending on the type of plants to be grown on a field, farmers can use various plant disease prevention and management methods, like selecting disease resistant or disease tolerant varieties, treating seeds with fungicides, and applying pesticides, and other similar substances on developing plants. Farmers should pay special attention to using these or other methods in time so that they have a maximum effect possible.

It is very important to remember that protecting plants in a timely manner is crucial for crop yield per hectare indicator – the sooner a problem is identified, the faster and easier it will be solved and the fewer field hectares will be affected.

With the help of a precision agriculture technology as well as traditional methods, farmers may increase yield of crops from farmland. Given that precision agriculture technologies initially appear to be expensive, the last consideration is crucial. On the whole, nevertheless, the costs are much lower than they would be with traditional agricultural practices. In order to precisely calculate the necessary fertiliser dosage and identify the best fertiliser kinds for a given area, producers can use this information. The use of precision farming technologies is also significant since it allows for better long-term planning of agricultural operations and real-time strategy adjustment in the event of unavoidable circumstances.

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