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RECOGNIZING COTTON SCENARIO SET IN INDIA

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Abstract:

This research explores the integration of satellite and drone imagery for enhanced cotton production forecasting. Traditional methods of crop monitoring and yield prediction often rely on ground-based data collection, which can be time-consuming and limited in spatial coverage. The advent of satellite and drone technology offers a transformative approach to agricultural monitoring, providing high-resolution, real-time data over large agricultural landscapes. In this study, we leverage satellite imagery with various spectral bands and resolutions to monitor cotton crops throughout their growth stages. Additionally, drone-based imagery is employed to obtain detailed, on-the-ground insights, allowing for a more accurate assessment of crop health, pest infestations, and other factors influencing cotton production. The combination of these two data sources enables a comprehensive understanding of the dynamic agricultural environment. Machine learning algorithms are applied to process and analyze the vast amount of satellite and drone imagery, extracting valuable information such as vegetation indices, soil moisture levels, and pest-related indicators. The integration of this data into a predictive modeling framework allows for the development of a robust cotton production forecasting system. This system aims to provide farmers, agronomists, and policymakers with timely and accurate information for decision-making, optimizing resource allocation, and improving overall crop management practices.

keywords : *Satellite, Imagery, Cotton Production*

INTRODUCTION

It is the most important raw material that is used in the textile manufacturing industry, in addition to being a key component of the automobile industry, the medical industry, and the national defence industry. It is of the biggest significance to have a crop yield prediction when it comes to agricultural production since it helps farmers to make educated choices about crop insurance, storage demand, cash flow budget, fertiliser, and water. In addition, it is essential to take into consideration that one of the primary goals of cotton breeding research is to choose genotypes that are appropriate for certain geographical areas. In the process of breeding cotton farmers, assessment of yield is another crucial component to take into consideration. When assessing yield, the standard procedure involves analysing the cotton crop in its whole after it has been harvested. This is done after the cotton crop has been harvested. Whether it be the harvesting of a whole cotton crop or the carrying out of destructive sampling throughout a large region, both of these tasks need a significant amount of time and labour. In recent years, there has been a significant improvement in the technology of remote sensing, which is now routinely employed for the purpose of agricultural monitoring. This technology has been utilised for a variety of purposes. Increases in the accuracy of yield projections are being made possible by the use of satellite remote sensing. The yields of a wide variety of crops, such as rice, wheat, maize, and others, are estimated by a significant number of academics via the use of satellite data. However, despite the fact that satellite remote sensing data are very useful because of the vast coverage they provide, many applications for precision agriculture continue to struggle with issues with the spatial resolution of the data. In order for many prediction models to be able to make more accurate predictions about agricultural yields, it is necessary for them to be working on large-scale projects at the county level and higher. It is not possible for these models to provide an explanation for the more minute aspects of variations in crop yields on smaller scales, such as single fields. Additionally, since clouds have a propensity to impede the return periods of satellites, it is not feasible to get timely information on crops during the whole of their growth cycle. This is because clouds tend to block the return periods of satellites. Agricultural research is increasingly making use of unmanned aerial vehicle (UAV) remote sensing as a result of the significant advancements that have been achieved in the development of lightweight sensor technologies and UAV platforms. This is due to the significant progress that has been made in these areas during the last several years. The use of drones that are able to acquire remote sensing photos of a high quality while flying at low altitudes has emerged as an appropriate solution for applications in the agriculture sector. Over the course of the last several years, significant progress has been made in the use of unmanned aerial vehicle (UAV) remote sensing for the purpose of identifying agricultural pests, field weeds, leaf area index, crop biomass, and quality prediction. When it comes to agricultural yield prediction, one method that is often used is the computation of the vegetation index (VI) by using images that were obtained by unmanned aerial vehicles (UAVs). similar to the conventional approach of yield estimate based on remote sensing, this method is also similar. In spite of this, the level of accuracy that may be accomplished via the use of single parameter modelling is not very advanced. The model that Huang created to estimate cotton yield by using the NDVI has a coefficient of determination (R2) that was equal to 0.47.

While it is conceivable that the accuracy of the prediction model might be enhanced by integrating more components, this is not guaranteed. An example of this would be a high-resolution digital camera that is mounted on a UAV. This camera has the capacity to take RGB images, determine colour characteristics, vegetation coverage, and other data, and as a result, it may enhance the accuracy of yield prediction (R2 = 0.97). In addition, the use of unmanned aerial vehicles (UAVs) that are fitted with lidar for the purpose of gathering information on the surface and height of the canopy may be instrumental in the generation of digital surface models (DSMs), which are very helpful in the identification of biomass. Utilising a large variety of unorganised images that have been gathered, the structure from motion algorithm (SFM) may be used for the aim of 3D reconstruction. This is accomplished by making use of the photographs. In order to construct a digital surface model from the orthophoto data that was collected by unmanned aerial vehicles (UAVs) that did not have lidar, we are able to make use of surface fusion modelling (SFM). With the use of time series remote sensing images, we will be able to collect crop growth in a number of different time periods. This will enable us to notice changes in the time dimension of the item that is being investigated in a very short amount of time. For the purpose of assessing the manner in which ground objects (such as farmland classifications, plant cover, crop growth, and land desertification) vary over the course of time, the use of this approach is absolutely necessary. In the field of yield prediction research, the yield measurement model that is based on time series data has much greater levels of accuracy and precision when compared to the model that is based on data from a single period.

When it comes to studies on the boll opening rate, the effect of defoliants, and intelligent agricultural equipment, the use of machine vision to separate cotton bolls from high-resolution remote sensing pictures is quite advantageous. The ability to divide cotton bolls from remote sensing photos is made feasible by the higher spatial resolution of the images provided by unmanned aerial vehicles (UAVs) in compared to the images produced by regular satellites. This is a considerable departure from the condition that existed before. Machine vision technologies have been used by a small number of researchers over the course of the last ten years in order to extract cotton boll components. The separation of cotton bolls from the background was accomplished by Zhang by the use of an object-oriented strategy. This was accomplished through the utilisation of near-infrared remote sensing pictures to capture cotton fields. Li did research on a method for segmenting cotton bolls collected from the field by using random forest classification. The methodology was used to segment the cotton bolls. Over the course of the last decade, significant progress has been made in the creation of a deep learning (DL) approach for various types of remote sensing.

Objective of this study

1. The review for recognizing cotton bolls from the picture.
2. Calculate the creation of cotton crop per hectare, in light of results and measurable examination of advanced picture information.

Cotton that has been genetically modified (GM) in India.

Protecting cotton against a broad variety of insect species, plant pests, and microorganisms is vital because cotton is susceptible to a wide range of seasonal and biological circumstances. Cotton is sensitive to a wide range of situations. Cultural techniques, such as selective breeding, as well as traditional ways, such as growing the cotton plant at the proper time, have been demonstrated to be useful in fighting assaults of this sort. Traditional methods include growing at the appropriate time. In the early 1900s, the invention of chemical pesticides led to an increase in production, which in turn required the implementation of adequate monitoring. To achieve greater levels of output, this strategy is usually considered to be the most efficient and tried-and-true methodology that has been established throughout time. pesticides are required for cotton more than any other crop; the traditional technique, which uses non-synthetic pesticides, is gaining popularity all over the globe due to the fact that it helps to preserve the quality of the soil and reduce the amount of pollution that is released into the environment. Genetically engineered cotton cultivars were developed in order to counteract the danger that is provided by herbivorous insects. This was accomplished by the development of a one-of-a-kind toxic protein that also serves as an antigen.

The beginning of the 1990s saw the introduction of genetically modified cotton to the Indian market. Not until the late 1990s, following extensive testing in the field, did the development of the ideal cotton variety begin to take shape. 2002 was the year that the government finally granted authorization for the Southern and Central States, while 2005 was the year that it went through with the approval process for the Northern States. The cultivation of twenty different types of Bacillus thuringiensis (Bt) cotton is currently being carried out in India at the present time. 20,000 farmers are involved in this cultivation process, which takes place on a total of 38,000,000 hectares of land throughout the world. Because of the significant increase in the cultivation of Bt cotton in India over the years, which now accounts for nearly forty percent of the total cotton cultivation, and because it is anticipated that it will constitute approximately seventy-five to seventy-five percent of the total cotton cultivation in the near future, genetically modified cotton and its evolution find an important place in the calibration of economic prospects for the nation's economy.

Crop Forecasting: Origin and History

When individuals evaluate policies and programmers primarily on their intentions rather than the results they create, they are making one of the most critical mistakes that people can make. One of the first economists to be awarded the Nobel Prize was Milton Friedman.

The crop in question In one definition of forecasting, the term "statement of the most probable magnitude of crop yield or production" is used. This definition is founded on the concept that the weather conditions will stay unchanged, that the number of damages will be substantial during the course of the crop season, and that the average of the years that came before will also be taken into consideration here. In the process of employing the archaic method of forecasting, which is based on the common assumption that yield area is multiplied by unit yield, the most important goal is to reduce the margin of error as much as possible. This article will discuss the two basic forms of forecasting, which are subjective forecasting and objective forecasting. The major focus of subjective forecasting is on human judgement and assessment, while objective forecasting is based on statistical approaches. Subjective forecasting is distinguished by this primary emphasis. published in 1956 by Spinks.

The evaluation of the current state of the crop is an important component of the objective yield forecasting process. In order to carry out this evaluation, it is necessary to observe, measure, and keep track of the crop's physical characteristics. These characteristics include the number of spikelets, the percentage of fertility, the percentage of damage caused by pests and biological hazards, the number of tillers, and the consideration of climate. Following the completion of the data collection process, the data are first collected and then subjected to analysis using the regression method. As a result of the graphical regression method's successful prediction in the New South Wales Wheat production estimate (Spinks, 1956), it gained widespread recognition as an ideal rival for the purpose of future crop forecasting. The approach gained considerable notoriety as a result of this success. It was observed that the magnitude of faults may be portrayed in an effective manner via the use of a graphical representation. The event was a defining moment that provided insight into the path that forecasting methods that use random sampling would take in the years to come for the future. In addition to this, it was employed in an efficient manner in the process of forecasting the production of yields for marginal crops in the state of New South Wales.

Both the forecast and the final estimate of the cost are released at separate times; the forecast is released at the beginning of harvest, while the estimate is made after the harvest has been finished. The release timing of the forecast is distinct from that of the final estimate. The statistician will do an analysis on the extracted indicators that were received from the survey point as well as the point estimates that were the outcome of the survey in order to arrive at the final forecast and harvest. Agronomic practices have been developed by farmers ever since ancient times via the use of methods that are referred to be "forecast." There is a possibility that straightforward calculations might be referred to as traditional techniques of predicting. The selection of the appropriate land and seed ratio, the quantity of fertiliser, and the timely planting of crops before rain are all operations that fall under this category. These strategies are designed to increase the yield to a level that is adequate or acceptable, and their purpose is to achieve this. Ever since the mediaeval times, the name "India" has been linked to various systems of agricultural forecasting and estimation. Arthashastra and the Tamil

Sangam Literatures both make mention to these procedures in their respective scriptures. The work of Roy in 2009.

The Cotton Industry and the Urgent Need for foresight

In addition to being an important economic activity on a global scale, the cultivation of cotton involves more than one hundred million smallholder farmers and is carried out in one hundred different countries. Cotton is the major source of money and income for these farmers, and it is also their primary source of nourishment. Due to the fact that the cultivation of cotton is dependent on a variety of external factors, the economic portfolio of the cotton industry is unstable and susceptible to changes in the market.

This irrationality is mirrored in the general economic state of the area, which in turn influences the policies that are implemented pertaining to the region's economy and politics. Because of this, it is vital to build an efficient approach to predict the elements that impact the economic portfolio in order to ensure quality economic planning and to give greater security on a global scale. This is because quality economic planning is key to provide better security. As stated by Basso, Cammarano, and Carfagna (2013), crop forecasting is an effective method that may be used over an extended period of time to reduce economic bottlenecks and troughs. Agricultural output and the activities that are related with it are the precursors of economic uncertainty, which is the reason why this is the case. The "Cobweb Model," which depicts a scenario in which a product becomes more costly in a short period of time, is being replicated in the agricultural sector, as it has been seen.

This model motivates farmers to produce more in subsequent seasons, which in turn stimulates them to produce more. In the end, the result is that there are more goods available at cheaper prices, which leads to a decrease in the market price, which in turn leads to economic instability and losses for farmers. Through the process of conducting an analysis of production when dependent variables are present, crop forecasting seeks to handle price volatility as its primary purpose. When it comes to the process of creating suitable policies, the precise evaluation of agricultural production has emerged as a critical component. Cotton is directly dependent on a number of businesses that are responsible for a substantial amount of economic activity. These industries include the garment industry, the housing furnishings industry, and the packaging industry for industrial items. A substantial amount of progress has been made in predicting models as a result of the passage of time and the introduction of modern technologies that make use of automation and computer software. This shift in emphasis took place after World War II, when governments all over the world refocused their attention on agricultural issues and the econometrics that are linked with them. The stochastic component and the deterministic variable are regularly imposed together in the bulk of the research that are conducted on statistical forecasting. As a result, this has made it possible to conduct efficient tests of theories or to measure the effects of policy at both the regional and global levels. The first econometric models were developed in 1940, and since then, they have come a long way. In economic policies that remained in theory until those policies successfully moved away from Keynesian economics, they continued to be a substantial component. This persisted until the conclusion of the transition. According to Cromarty (1959), econometric models that are created from statistical data are beneficial in the process of generating a mathematical theoretical model that can estimate the various structural factors. This is because these models are able to take into account historical data. The creation of an intrinsic forecasting and associated econometric model is of the highest requirement for the survival of India's agrarian economy. India is predominantly an agricultural nation, hence the development of such a model is of the utmost importance.

This enables the formulation of policies that were previously ineffective and the depreciation of blockheads in the long run of an economy that is sustainable. However, the dynamics of the economy and the production of agricultural goods are completely unexpected. Immediately after its attainment of independence, India placed a significant amount of reliance on the weather conditions in order to sustain agricultural production. These circumstances were prone to being unanticipated and posed a major danger to the parties involved. The overall production was affected by a number of other variables, including the presence of diseases and pests, the decrease in rainfall, and the lack of twelve seeds. For millions of farmers, the market price is the deciding element in determining how they will make a living under these conditions. Using forecasts and crop predictions that make use of statistical data and structural features, the cobweb model demonstrates the bottleneck in pricing and production of crops. This bottleneck may be avoided by using forecasts and crop predictions. With the aid of the price profile, farmers are able to standardise their production now as well as for the future. This is true for both the present and the future. The idea of demand and supply, in addition to the computation of production costs, serves as the basis for the price parameter in the scenario involving India. A vital demand estimate is formed as a result of the problem of decreased elasticity of agricultural products in the near term. This, in turn, has an influence on both the price and the production of agricultural goods which will occur in the future. There are two factors that have led to the transition of cotton into a political crop: the first is the crop's significance in international trade, and the second is the contribution it gives to the economy of emerging countries. In the majority of the countries in which it is grown, it plays a big role in the acquisition of precious foreign currency and composes a large portion of the total amount of tax income and gross domestic product. In addition, it is a significant contributor to the overall economy. Cotton exports are essential to the economies of a great number of African nations, as well as those of the Soviet Union and Central Asian countries. Cotton serves as a "salvation from adversity" for these nations. Forecasting satisfies the need to obtain a perspective on the behaviour of the market in the future and how it will affect the lives of individuals who are associated with it. This is especially important when taking into consideration the importance of the harvest.

Scenario set in India

It is widely held that cotton has a major position among the crops that are cultivated in the Indian Subcontinent that are not suitable for human consumption. In terms of the crops that are farmed there, it is among the most significant ones. It is believed that the cultivation of cotton started on the Indian subcontinent; however, it was not used as a crop for the textile needs of the local people; rather, it was sold to other ancient civilizations that required it. Cotton was used for the production of textiles. In ancient texts, historians such as Herodotus and Megasthenese emphasised their enthusiasm for the rich texture and lightweight properties of Indian cotton, as well as its superb drape. They also praised the wonderful drape offered by Indian cotton. The only country in the world that cultivates all four of the most important commercial species of cotton is India, which is also the only country producing cotton. The southern and central parts of the country are the primary locations for hybrid cotton cultivation, which is another aspect of the nation's agricultural sector. Among the varieties of cotton that are cultivated in this nation are G. hirsutum and G. barbadense, both of which are tetraploid species that include two sets of chromosomes as their individuals. In addition to being of a high grade, which is often selected by textile makers, it is responsible for seventy percent of the entire cotton output.

These particular varieties of cotton are also known as New World Cotton from time to time. On the other hand, Asiatic Cotton, which is a species that is diploid and has two n=26 and is also known as "Old World Cotton," was only discovered in Asia and is responsible for twenty-five percent of India's total cotton output. There is a significant amount of documentation in historical papers and sources that demonstrates the significance of cotton and its connection to the cultural history of India. Cotton was the fundamental political and economic centre of Indo-Britain and British relations throughout the post-medieval era. While India was still under British administration during the beginning of the nineteenth century, the agricultural sector got increasingly commercialised, which led to a closer integration with the world economy. This occurred throughout the time period for which India was still under British authority. It was at this period that India began to become a big producer of cotton. The Commonwealth nation was a vital contribution to the commencement of the Industrial Revolution, which began in Europe in the 17th century with the introduction of mechanised textile manufacturing operations. The Industrial Revolution was attributed to the mechanisation of textile manufacturing activities. The manufacture of cotton underwent substantial transformations as a result of the inventions of the flying shuttle, the Spinning Jenny, and the Water Frame, which occurred between the years 1738 and 1764. In addition, the importation of low-cost textile equipment and textiles created in Lancashire led to a large growth in the production of cotton yarn, which was in line with the requirements of the continuously expanding population in the region. This revolution in technology resulted in the transition of the cotton manufacturing business in India from a traditional to an industrialized one, which ultimately led to the demise of the traditional weavers and handloom industry in India. Instead of being exported, the yarn that was produced was put to use in meeting the requirements of the local textile industry.

CONCLUSION

The application of image processing allows for the determination and forecasting of the yield of a crop in a particular region. The use of digital photographs is the method that is utilised in the process of estimating and detecting cotton. A technique for identifying the area of a cotton plant has been presented, and it is based on the many components of the digital picture of the cotton plant for identification. The estimate of yield was established on the basis of the conducted study and the recognised area of the cotton plantation. An illustration of the effectiveness of identifying and predicting cotton output is provided by the outcome of the experiment. The digital photographs are capable of being used effectively for the purpose of identifying areas based on ground observations. Based on the findings of my experiments, I could draw the following conclusions: The photograph was taken with a camera at a height of 5 metres above the ground and at a distance of metres from the crop An algorithm that estimates cotton crop output was created based on image processing. This algorithm examines a picture of the cotton crop when the cotton bolls are present in their entire configuration. 3. The algorithm that has been provided may be used for either the estimate of production or the acquisition of images throughout the harvest phase of cotton.

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