GIS Applications in Agriculture

(*Abdullah Zaid[1], Shivam Chaurasia[1], Shivani Dubey[2] and Rohit Rawat[2])
[1]Banda University of Agriculture and Technology, Banda, U.P.
[2]Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P.
*Corresponding Author's email: abdullahzaid265@gmail.com

Geographic Information System is a system that has been put in place specifically to capture, store, deploy, evaluate and present geographic data. This system has proved effective in the agricultural sector in various ways. The tools that are represented by the system have enabled users to create questionnaires, which are interactive in nature, analyze three-dimensional information, edit data in maps and present the findings of the operations. GIS comes as an advantage to farmers because it helps them in achieving the best in terms of production and reducing extra costs, which could have been incurred in operations, resulting in better management.

Geographical Information System (GIS)

GIS is a technology that provides the means to collect and use geographic data to assist in the development of Agriculture. The GIS software makes it possible to synthesize large amounts of different data, combining different layers of information to manage and retrieve the data in a more useful manner. The geographical information system is also called as geospatial information system. It is an information system capable of integrating, storing, editing, analyzing, sharing, and displaying geographically referenced information. A GIS allows access to large amounts of information quickly and efficiently. Geographic Information Systems let you visualize information in new ways that reveal relationships, patterns, and trends not visible with other popular system. A GIS is a thematic mapping system, meaning you can produce maps based on themes such as soils or hydrology. Map features can be linked to corresponding information contained in database tables. Another advantage of GIS is that it is a dynamic product rather than a static product, making it easy to update, edit, and reproduce maps. Multiple layers of maps can be quickly displayed in a variety of overlap, scales, and combinations to fit the needs of the user. Geographical Information System can be used for scientific investigations, resource management, asset management, environmental impact assessment, urban planning, cartography, criminology, history, sales, marketing, and logistics

Importance of GIS in agriculture

1. **Forecasting of Crop production:** By using remote sensing technology, we can predict the expected crop yield and production in agricultural land and we also can estimate about the quantity of crops under specific situations.
2. **Estimation of soil moisture:** By using remote sensing technology, we can measure soil moisture. With the help of these technologies, we can get soil moisture data that will help us in determining the moisture quantity in soil and estimates about the crop type that can be sown in that soil.

3. **Soil type mapping for planning of agriculture:** on a broad scale it is extremely important to know different types of soils, type of crops they can support and areas having the type of soil. This information if used effectively can greatly improve the agricultural output and its quality. Some attributes of soils are: humus content, nutrient content, name etc.

4. **Analysis of Cropping Systems:** By using remote sensing technology, we can study the planting system of various crops. These technologies can also be used for flower growth in the industry of horticulture. By which we can analyze the pattern of flower growth and predict with the help of various analyses.

5. **Crop progress and crop damage Assessment:** By using remote sensing technology, we can determine the penetration of land. A ratio of crop that has been damaged and progress of crops, left in farmlands.

6. **Identification of harvesting and planting dates:** By using remote sensing technology, now farmers can notice a wide variety of components which includes types of soil and weather patterns to forecast the harvesting and planting dates or seasons of each crop

7. **Estimation and modeling of crop yield:** By using remote sensing technology, experts and farmers can predict the expected yield of the crop for agricultural land by analyzing the crop quality and the area of that land

8. **Identification of disease and pest's infection:** By using remote sensing technology, we can identify the pests in agricultural land and provide data on correct mechanism to control pests. So that we can get rid of this disease and pests on the land.

9. **Rivers/ distributaries mapping:** these maps show the geographical location of the different river and distributaries systems in and around an area. Knowing his is helpful in locating nearest source of water and designing of most economical canal systems. • Attributes: name, volume, depth, width et

10. **Land use mapping:** these maps give information about how the land is already being used. It helps in analyzing how effectively the land resources are being used and in coming up with more economical suggestions for the same in addition to keeping updated records used for various other calculations such as kind of usage, total forest coverage, total agricultural output of an area, estimated urbanization of an area etc

11. **Meteorological mapping:** Rainfall patterns, climatic conditions, seasonal changes and predictions are the areas dealt with under this kind of mapping. This is important information required by famers and agriculturists to plan the type of farming most suitable and economical. It also helps in estimating how much water is to be let out into the canal systems in accordance to the predictions of the rainfall intensities.

12. **Forest degradation:** The rapid depletion of forests made it essential to know the rate and trend of this degradation so that timely measures could be taken to prevent further loss of forest resources. Timely and accurate information for detecting changes over a period of time is required for forest ecosystems

13. **Environmental Impact Analysis (EIA):** EIA is an important policy initiative to conserve natural resources and environment. Many human activities produce potential adverse environmental effects which include the construction and operation of highways, rail roads, pipelines, airports, radioactive waste disposal and more. Environmental impact statements are usually required to contain specific information on the magnitude and characteristics of environmental impact. The EIA can be carried out efficiently by the help of GIS, by integrating various GIS layers, assessment of natural features can be performed.

14. **Zoning of Landslides:** hazard Landslide hazard zonation is the process of ranking different parts of an area according to the degrees of actual or potential hazard from landslides. The evaluation of landslide hazard is a complex task. It has become possible to

efficiently collect, manipulate and integrate a variety of spatial data such as geological, structural, surface cover and slope characteristics of an area, which can be used for hazard zonation

15. **Management of Natural Resources:** By the help of GIS technology the agricultural, water and forest resources can be well maintain and manage. Foresters can easily monitor forest condition. Agricultural land includes managing crop yield, monitoring crop rotation, and more. Water is one of the most essential constituents of the environment. GIS is used to analyze geographic distribution of water resources. They are interrelated, i.e. forest cover reduces the storm water runoff and tree canopy stores approximately 215,000 tons carbon. GIS is also used in afforestation.

16. **Identification of Volcanic Hazard:** Volcanic hazard to human life and environment include hot avalanches, hot particles gas clouds, lava flows and flooding. Potential volcanic hazard zone can be recognized by the characteristic historical records of volcanic activities, it can incorporate with GIS. Thus an impact assessment study on volcanic hazards deals with economic loss and loss of lives and property in densely populated areas.

Data Capture

GIS applications include both hardware and software systems. These applications may include cartographic data, photographic data, digital data, or data in spreadsheets. Cartographic data are already in map form, and include information such as the location of rivers, roads, hills, and valleys. Cartographic data may also include survey data and mapping information that can be directly entered into a GIS. Photographic interpretation is a major part of GIS. Photo interpretation involves analyzing aerial photographs and assessing the features that appear. Digital data can also be entered into GIS. An example of this kind of information is computer data collected by satellites that show land use, the location of farms, towns, and forests. Remote sensing provides another tool that can be integrated into a GIS. Remote sensing includes imagery and other data collected from satellites, balloons, and drones. Finally, GIS can also include data in table or spreadsheet form, such as population demographics.

GIS Maps

Once all the desired data have been entered into a GIS system, they can be combined to produce a wide variety of individual maps, depending on which data layers are included. One of the most common uses of GIS technology involves comparing natural features with human activity. For instance, GIS maps can display what man-made features are near certain natural features, such as which homes and businesses are in areas prone to flooding. There are different types of maps used in GIS mapping such as Cluster map, it is used in a way to make sense of point layers that have a large number of features This cluster point usually uses a combination of color, size and labelling to communicate how many separate points each cluster encompasses, heat map a heat map is used in instances where our location data is so dense and tightly packed that we can't make visual sense of it. Heat maps are ordinarily used when mapping points, bubble map is also known as a "graduated marker map", a bubble map works in exactly the same way as a quantity map. But uses a range of bubble sizes rather than colors to visualize the variance. Quantity map this type of visualization is useful for identifying patterns and trends based on location and is most often used for business analysis and demographics mapping, category map a category map allows us to visualize which category each location belongs to. Indian irradiation map has been shown in Fig.1
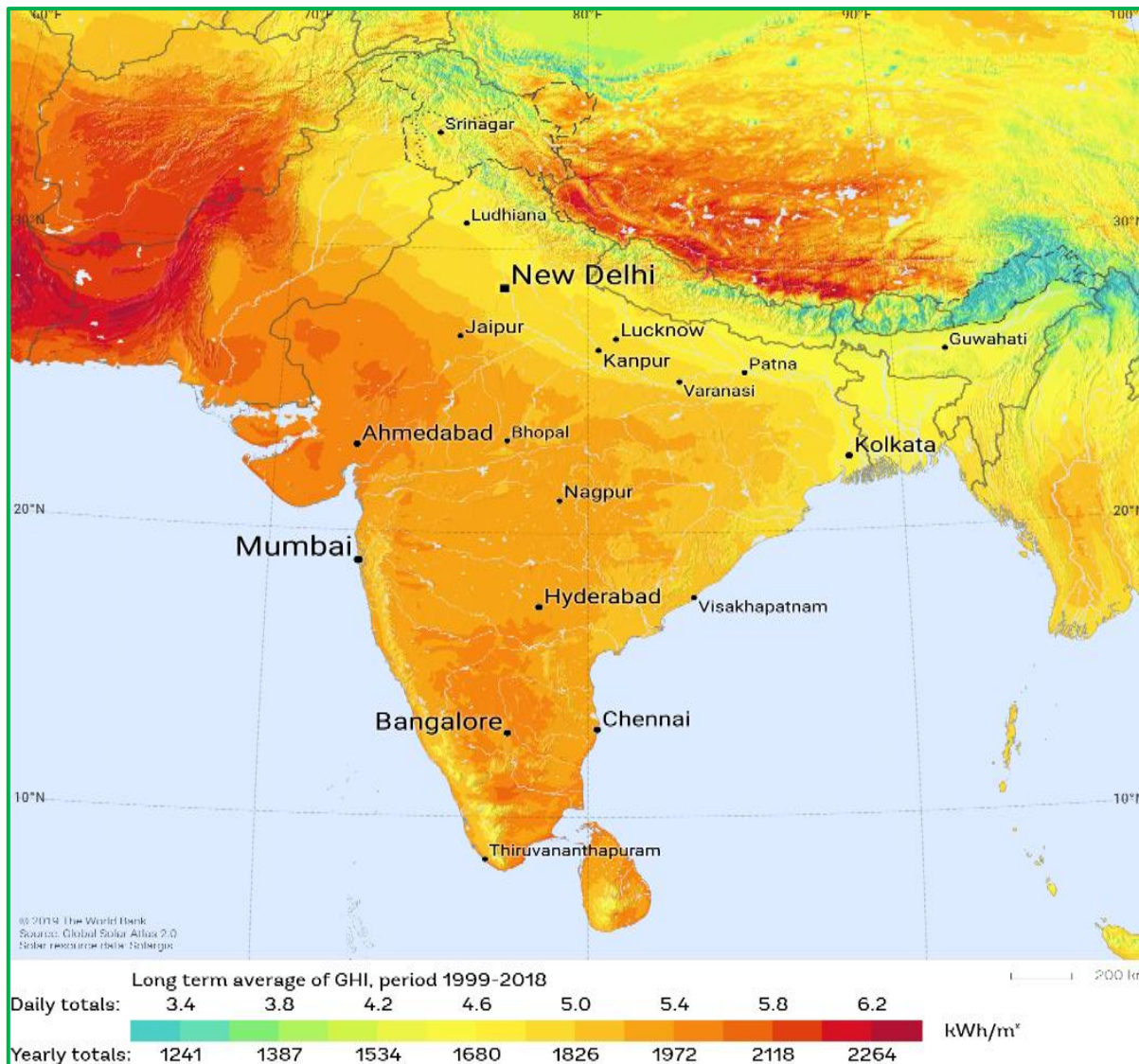
Fig.1

Conclusion

The use of GIS in agriculture has increased at a rapid pace during the recent decades and the number of applications and the prominence of GIS has further amplified in the recent years due to advances in digital technologies that have been leveraging GIS as an essential partner technology for assessing crops, soils, and their environments. GIS is new and emerging applications in high fidelity crop monitoring, yield prediction, precision farming, and supply chain management for both primary produce and biomass utilization towards energy production. Considering the multitude of capabilities and insights GIS provides including the recent enhancements to collect and analyze data in real time has further elevated its importance in providing location/spatial intelligence needed for improving the productivity and profitability of farms through precision practices. With the current and emerging applications, in combination with existing and newer partner technologies, GIS has a pivotal role in achieving sustainable agricultural productivity.