



Application of GIS in agriculture

Nandini Palthyavath¹, Niharika Mallepally², Shalini Vankudoth³ and Sowmya Porandla⁴
Ph.D. Scholar, PJTSAU, Rajendranagar, Hyderabad,
<https://doi.org/10.5281/zenodo.7239716>

Introduction

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, analyse 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.

What is geographical information system (GIS)?

A geographical information system (GIS) is a thematic mapping system, which allows for the production of maps based on themes such as soils or hydrology. The system requires preliminary basic information that is relevant to the particular project discipline. The importation of information into a GIS would require time and attention, mainly because this information will provide the basic knowledge of the territory and on the individual parameters, and it is difficult to modify in a second time. Geographical information systems have been in existence for about three decades, but only in the last 10 years, these applications have widely been used for agronomic and natural resource management. Geographical information systems provide valuable support to handle out voluminous data that are generated through conventional and spatial format and for the integration of these data sets. The GIS technique uses a digital map that allows the users to view, update, query, analyse and manipulate the spatial and tabular data either alone or together, within few minutes. Unlike paper maps, GIS can prepare and manage large collection of agronomic and land resource data necessary for crop production.

Importance of GIS to agriculture

Agronomic activities are spatial and the need to place site-specific information in a spatial and long-term perspective would require special models that can be used to calculate spatial variation in crop growth and monitor variations in trend with a time scale appropriate for guiding decisions. As opposed to farmers' typical manual adjustment, GIS helps farmers to manage within field variable rate application, which results from spatial variation in crop yields within a field. Hence, GIS enhances the assessment and understanding of variations in a field crop. It was also reported that the yield can then be estimated or used for future reference and the economic inputs and outputs can be calculated based on anticipated yield.

Applications of GIS in agriculture

1. Agricultural mapping

The application of GIS in agriculture is important because is very helpful in mapping the current and future variations in the sleet, crop output and temperature of the soils. The mapping of the current features of a farm enables scientists and farmers to work together towards the same goal of creating more diverse, effective and efficient farming techniques. In addition to that, this helps in increasing food production in a country and can eliminate the problems of food shortages in specific countries.

2. Soil analysis

Geographic Information Systems is also important in agricultural soil analysis because it helps in determining the type of soil, what plants to grow in it and how to maintain the nutrients present in the soil to the benefits of the plants.

3. Data combination

GIS, together with many variations in the USDA sectors, have been used in the combination of large amounts of data into a data set. For instance, countries such as the United States use GIS systems to solve any crop issues that arise, protect the crops and provide solutions to fake claims of crop damage.

4. Interaction with farmers

Geographic Information Systems have helped farmers, especially those in the United States to access the data on their lands. This does not necessarily require them to have the GIS themselves. In addition to that, this also helps them in interacting with the data, asks questions and provides reliable and valuable on-ground data that cannot be generated through the use of satellite. This, in turn, increases the accuracy of the data provided by the machine in the end by about ninety percent.

5. Nutrient determination

Nutrients in a field need to be determined first before farmers come to a decision on adding nutrients to the soil. Geographic Information System is used to study the different statuses of nutrients in a field to enable farmers to reach a specific requirement for the external application of nutrients. This helps in the combination of computer software modelling analysis with site analysis for a conclusive interpretation of varying outputs and inputs.

6. Assemble information

Geographic Information System is used in assembling different layers of information such as soil moisture, nutrients, elevation, and topography, to aid in the production of a map, which will show some of the factors that influence crop yield. Furthermore, the yield is used as a future reference and the economic inputs and outputs are premeditated based on the expected yield.

7. Store geospatial data and produce maps for land inventory

The data that was provided by the Geographic Information System indicated whether the land in question is capable to support agriculture, wildlife, tourism and forestry among others. Land that is capable of supporting agriculture is essential because it helps in the production of crops both locally and globally.

8. Precision farming

The sensors present in tractors, satellites and in fields play a vital role in collecting data. Using Geographic Information System in this area helps in the shaping of the collected data into viable information that is accessible and easy to interpret by land managers and farmers. In addition to that, this helps in the making of informed decisions.

9. Real-time mapping

In the past few decades, the use of satellites and drones has become popular and has drastically grown. Using satellite technology helps in the collection of real-time data from the surface of the earth, accesses, and monitors the condition of the land. In addition to that, the use of drone technology has aided in the collection of data, especially local field data such as the height of plants, diseases, flower count and the presence of weed among others. This improvement in technology has helped reduce the amount of time that could have been consumed in walking to and from the field in search of data.

10. Raising alertness

Farming is one of the agricultural sectors that need awareness, especially about crops and their availability. Geographic Information System comes handy in this sector because of its effectiveness in increasing food scarcity awareness. Once the affected area has been located, the

necessary assistance is provided. The underlying causes of food insecurity are determined and the GIS data is used in safeguarding the various communities or areas that have been affected.

11. Historical data comparison

The availability of food in the world has drastically reduced because of the increasing number in the population. Research has shown that in order to meet the future needs for food, the current production of crops needs to be doubled by the year 2050. Geographic Information System is used in real-time analysis and in the comparison of historical data.

12. Analyse and visualize agricultural environments

A farm can only be successful and profitable when there is a balance between its inputs and outputs. Geographic Information System has proved to be handy in this sector because it analyses and visualizes the agricultural environment and the flow of work in these environments. This has proved to be beneficial to those involved in the farming industry.

13. Increase production

Furthermore, GIS is applied in agriculture to enable farmers to increase their production. In addition to that, farmers are also able to reduce costs and manage their land more effectively and efficiently. This is done through the scientific analysis of production data, which is stored at the farm manager's office.

Conclusion

The GIS is an excellent informative tool that enhances visualization and ease of analysis and handling of spatial data. Its digital map allows for the periodic review of soil fertility status as it improves and updates information on crop, soil and the prevailing climatic conditions as they affect agronomic practices, thus greatly enhancing the management of finite resources and accurate land-use planning due to its accurate knowledge base. The benefits of GIS applications could be better exploited with increase in the level of awareness and understanding of the potential use of GIS and related technologies in the assessment, storage, processing and production of data ranging from site-specific farming systems to global food production and food security issues.

References

- Bhagat, V.S., 2009. Use of Landsat ETM+ data for detection of potential areas for afforestation. *International Journal of Remote Sensing*. 30(10):2607-2617.
- Kingra, P.K., Majumder, D. and Singh, S.P., 2016. Application of remote sensing and GIS in agriculture and natural resource management under changing climatic conditions. *Agricultural Research Journal*. 53(3):295-302.
- Oshunsanya, S. and Aliku, O. 2016. GIS applications in agronomy. *Geospatial Technology- Environmental and Social Applications. Roma, Italia. IntechOpen*, pp.217-234.