NEW ERA AGRICULTURE MAGAZINE

Applications of GIS in Agricultural Mapping

Rajesh Kumar[1], Chaman Singh[2] and Lalit Kumar Verma[3]

Introduction

Agriculture is one of the most important sectors for ensuring global food security. Over the years, technological advancements have played a significant role in improving agricultural practices. Among these advances, Geographic Information Systems (GIS) have emerged as a powerful tool in agricultural mapping. By integrating spatial data with advanced analytical capabilities, GIS has revolutionized precision farming, enabling farmers to make informed decisions and optimize resource use.

What is GIS in Agriculture?

Geographic Information Systems (GIS) is a tool that lets users create multi-layered interactive maps that can be used for the visualization of complex data and for spatial analysis. How is GIS related to agriculture? The use of GIS in agriculture enables farmers to map field data, organize and analyse it, and monitor their crops remotely.

GPS, robotics, drones and satellite monitoring have all contributed to farm automation. These technologies are the basis for collecting GIS data. By visualizing data, GIS helps farmers identify trends and patterns, detect change, and address issues quickly. Precision agriculture relies heavily on GIS to collect and interpret large-scale field data for informed decision making.

GIS in Agriculture Mapping:

Geographic Information Systems (GIS) is a technology that combines spatial data (such as satellite imagery, aerial photographs and GPS data) with attribute data (such as soil composition, crop yields and weather patterns) to create layered, interactive maps. combines. In the context of agriculture, GIS plays an important role in mapping and analyzing various factors affecting crop production. It helps farmers to get valuable information about soil condition, water availability, topography, disease incidence and other important variables affecting agricultural productivity.

Rajesh Kumar[1], Chaman Singh[2] and Lalit Kumar Verma[3]

[1]Research Scholar, Department of Soil Science & Agricultural Chemistry, R.S.M. (P.G.) College, Dhampur, Bijnor (U.P.)-246761

[2]Professor & Head, Department of Soil Science & Agricultural Chemistry, R.S.M. (P.G.) College, Dhampur, Bijnor (U.P.)-246761

[3]Research Scholar, Department of Agricultural Economics & Statistics, R.S.M. (P.G.) College, Dhampur, Bijnor (U.P.)-246761

Applications of GIS in Agricultural Mapping:

GIS (Geographic Information System) provides many advantages in agricultural mapping. Some of the major ones are as follows-

1. **Spatial Analysis:** GIS allows farmers and agricultural researchers to perform spatial analysis on different geographic data layers. By overlaying different datasets such as soil type, crop yield data, weather patterns and pest distribution, farmers can gain insight into spatial relationships and make informed decisions about land management, crop selection and resource allocation.
2. **Precision farming:** GIS enables precision farming techniques by providing detailed information on the variability of soil characteristics, water availability and crop health in a region. Farmers can use this information to optimize fertilizer, water and pesticide use, minimize waste and environmental impact, as well as maximize crop yields.
3. **Resource Management:** By integrating GIS with data on soil properties, topography and weather conditions, farmers can optimize resource management. They can determine the best areas for irrigation, identify areas prone to erosion or flooding, and make informed decisions about land-use planning, which will lead to more efficient and sustainable agricultural practices.
4. **Climate Change Adaptation and Risk Assessment:** Climate change poses significant challenges to agriculture, with extreme weather events becoming more frequent. GIS allows farmers to assess and mitigate the risks associated with climate change. By analyzing historical weather data and mapping climate patterns, farmers can make informed decisions about crop selection, planting schedules and water management. GIS also helps identify areas vulnerable to soil erosion, flooding or drought, thereby helping farmers implement proper land management practices and adopt resilient farming techniques.
5. **Land Use Planning:** GIS helps in land use planning and site selection for agricultural activities. It considers factors such as soil fertility, drainage, slope and proximity to markets or processing facilities. By spatially analyzing these factors, farmers and policy makers can make informed decisions about land allocation, farm

layout and the location of infrastructure such as irrigation systems or storage facilities.

6. **Crop rotation and planning:** GIS helps in crop rotation and planning by mapping historical yield data, soil characteristics and crop suitability indices. These maps provide farmers with valuable information to make informed decisions about crop rotation, ensuring soil health and reducing pest and disease risk.
7. **Crop monitoring and Disease management:** GIS facilitates real-time monitoring of crop growth, allowing farmers to detect anomalies and respond quickly to changes in plant health. By incorporating satellite imagery, drone data, or sensor data, farmers can identify areas affected by pests, diseases, or nutrient deficiencies and take appropriate measures, such as targeted pesticide application or nutrient supplementation.
8. **Yield Analysis and Forecasting:** GIS-based models can be used to estimate crop yields based on historical data, weather conditions, soil properties, and other variables. This information helps farmers plan their planting schedules, forecast future production, and make informed decisions about crop rotation and diversification.
9. **Decision Support System:** GIS acts as a decision support system for farmers, providing them with valuable information to optimize their operations. By visualizing data on maps, farmers can easily interpret complex spatial patterns and make data-driven decisions related to field management, machinery deployment and logistics.
10. **Environmental Impact Assessment:** GIS enables farmers to assess and reduce the environmental impact of agricultural activities. By analysing factors such as proximity to water bodies, slope and soil erosion potential, farmers can identify sensitive areas and implement appropriate measures to reduce soil erosion, water pollution and other negative environmental impacts.
11. **Market analysis and decision support:** GIS provides valuable information about market trends and consumer demand, helping farmers make informed decisions about crop selection and production planning. By combining market data with geographic information, farmers can identify potential markets, analyze transportation routes, and optimize

supply chains. GIS also facilitates analysis of demographic data, enabling farmers to target specific consumer segments and optimize their production accordingly. By integrating GIS with other technologies such as Internet of Things (IoT) and Big Data Analytics, farmers can access real-time information on market conditions, price movements and customer preferences, thereby increasing their competitiveness and profitability.

12. **Policy planning and compliance:** GIS can help policy makers develop agricultural policies and regulations. By mapping land-use patterns, identifying areas of high agricultural activity, and analyzing the impact of various policies, governments can make informed decisions to promote sustainable agriculture, conservation efforts, and rural development.

Conclusion:

The integration of GIS technology into Agricultural mapping has transformed agricultural practices by enabling accurate and data-driven decision making. GIS has revolutionized the way farmers manage resources, monitor crops, and respond to environmental factors. As technology continues to advance, the potential of GIS in agricultural mapping will further expand, promoting sustainable and efficient agricultural practices.

Reference:

1. Ghosh, Parmita & Kumpatla, Siva. (2022). GIS Applications in Agriculture. 10.5772/intechopen.104786.
2. GIS In Agriculture: https://eos.com/blog/gis-in-agriculture/#
3. Hedley, C.B.; Knox, J.W.; Raine, S.R.; Smith, R. (2014). Water: Advanced Irrigation Technologies. *Encycl. Agric. Food Syst.*, 5, 378–406.
4. Kuma, A., G.N., Ghosh, S., Venniyoor. (2007), Application of Remote Sensing in Agriculture – Experiences, Food and Nutrition Security Community, New Delhi, 9 February
5. Molly E. Brown (2015). Satellite Remote Sensing in Agriculture and food security assessment, *Procedia Environmental Sciences* 29
6. Panday D, Maharjan B, Chalise D, Shrestha RK, Twanabasu B (2018) Digital soil mapping in the Bara district of Nepal using kriging tool in ArcGIS. PLoS ONE 13(10): e0206350. https://doi.org/10.1371/journal.pone.0206350
7. Panday D. (2012). Adapting Climate Change in Agriculture: The sustainable

way in Nepalese context. Hydro Nepal Special Issue: Conference Proceedings.; 91–94.

8. Tayari, E. *et.al*, (2015). Role of GPS and GIS in Precision agriculture, *Journal of Scientific Research and Development* 2 (3): 157-162.