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Application of GIS in Farm Mechanization

Rathinavel S[1]*, Balaji Kannan[2], Kavitha R[3], Ramachandran J[4]
[1]PhD Scholar, Dept. of Farm Machinery & Power Engg., Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University, Coimbatore
[2] Professor and Head, Dept. of Physical Sciences & Information Tech., Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University, Coimbatore
[3] Professor and Head, Dept. of Farm Machinery & Power Engg., Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University, Coimbatore
[4]Teaching Assistant, Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University, Coimbatore

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Abstract

Geographical Information System (GIS) is a viable tool for precision farming. Under precision farming, all the farm operations are limited to optimum use of resources with increased yield. In this scenario, agricultural mechanization expands with combination of GIS applications globally. Hence, an attempt was made to collectively study the GIS applications in agricultural farm mechanization. The article discusses the GIS applications in mechanization aspects such as crop management, inputs and protection.

Introduction

GIS creates visual data representations and in order to make informed decisions, it performs spatial analyses. Also it makes use of the combined operations of data, software and hardware. Industrial standard software among various GIS softwares is ESRI's ArcGIS. The major utilization lies in the map making, drawing boundaries etc. An important factor facilitating the GIS use is that, it is free of cost at many points of its process.

More complex spatial analyses might compare variables like soil type, slope, rainfall amount, wind direction, aspect, topography, planning of drainage and site suitability as well as risk prevention from flood, drought, erosion, and disease. With these it helps in monitoring the health of individual crops, estimation of yields, maximizing the production. Future food security forces the increased production worldwide, which in turn creates a wide and advanced development in farm mechanization. Hence in the view of modern farm mechanization, GIS emerges as an important tool in enhancing the modern mechanization

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including tillage, nutrient management, farm management, harvesting, crop protection and management.

Tillage

Prime use of GIS lies in the map making and/or digitizing the fields. Digitizing the map data of the field assists in the planning the field. This ultimately enhances the autonomous driving technology. Apart from resolving the labour shortage, drudgery issues the autonomous driving technology favours the accuracy in tillage pattern, improved field capacity and saves energy.

Since the soil type and type of tillage has a significant effect, Vilček *et al.* (2019) identified the suitable location of soils for reduced tillage and No-Till Farming by GIS means.

Nutrient Management

For precise application of crop inputs (protection, management and enhancement), exact location of the target is mandatory which is provided by GIS mapping.

GIS helps in studying the various statuses of nutrients in a farm to enable us to reach a specific requirement for the external nutrients application. By the combined use of software modelling analysis and site analysis gives a conclusive interpretation of varying inputs and outputs. When the GIS hardware like drone can collect the data in the form of image/map and facilitates smart fertilizer application equipments post processing the data. Landsat 8 is an observation satellite which captures 9 bands of the visible light spectrum, orbits the earth every 16 days. The captured light spectrum can be applied in calculation of factors nutrient deficiencies. Variable Rate Technology (VRT) relies on the GIS support for a faster operation through the integration of mapping.

Song *et al.*, 2021 proposed variable-rate fertilizer control system coupled with drone based granular fertilizer spreader through prescribed map.

Crop Protection

GIS can play a vital role in crop protection through its data processing and transfer. Once a GIS system detects weeds infestation in a given field, it transfers the signal to the automated weeder to initiate its work. As discussed above, Landsat 8 can help in providing the light spectrum for identifying insect infestation and plant diseases. VRT is not limited to fertilizer application but also applicable in providing pesticide, weedicide and seeds.

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Machinery management

The timeliness of an operation such as tillage, harvest, fertilization etc are important factor in deciding the crop yield. Hence, timely operation requires the enough number of machinery units associating with the field capacity and size.

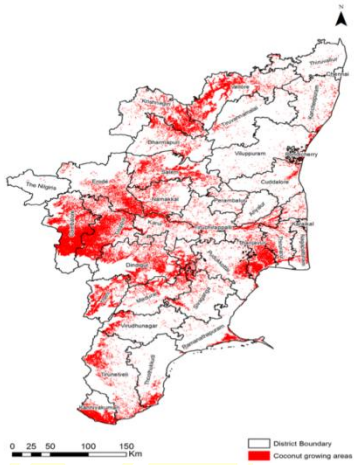

Fig.1 Coconut growing areas in Tamil Nadu State (India)

Source: *Kannan et al.,(2017)*

Fig.1 shows the Coconut crop locations in Indian state, Tamil Nadu mapped through remote sensing and GIS. Crop mapping can be coupled with timeliness of operations, to arrive at the number of machineries/units required for the selected crop in a given season. Also mapping can help in locating the custom hiring centres and its machine count.

Harvesting

The harvesting combines use the GIS for mapping the yield, and it is stated by the researchers as GIS helps in increasing the efficiency of combines. Robotic and autonomous navigating combines were based on the GIS similar to autonomous tractors as discussed earlier. The crops such as wheat, rice, soybean, sunflower, citrus were experimented with GIS for yield estimation.

Conclusion

With this discussion, it can be concluded that GIS is an effective and emerging tool for enhancing the mechanization goals. Indirectly, the GIS applications are useful in food and nutritional security in a global perspective. Integration of GIS with farm engineering is inevitable for modern mechanization and the potential of the same has to be utilized by the researchers.

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