ABSTRACT

The agricultural sector, a cornerstone of food security and economic stability, contributes significantly to India's GDP, with an estimated global market size of over $12 trillion. Despite technological advancements, nutrient deficiencies in crops continue to pose a challenge, especially in states like Karnataka with diverse agro-climatic zones. This study targets these challenges by employing data-driven methodologies to identify nutrient imbalances and devise actionable solutions. Emerging opportunities in predictive analytics and machine learning pave the way for optimizing agricultural planning. Existing algorithms, such as regression modeling for trend analysis and nutrient exchange frameworks, offer a theoretical foundation for this project. However, they are often constrained by the absence of localized solutions that address both deficiencies and surpluses efficiently. This gap motivates the present work, aiming to enhance nutrient adequacy and crop productivity through innovative, district-level interventions.

The methodology involves the integration of district-level crop production data, nutrient composition, and dietary requirements specific to Karnataka. Python libraries like pandas and scikit-learn are used for data preprocessing and modeling, while linear regression is employed for production trend projections. A unique nutrient surplus-deficit exchange mechanism is developed to optimize inter-district nutrient distribution. Assumptions such as a uniform annual growth rate of 5% and consistent dietary needs are incorporated to guide the analysis. The study is carried out in a sequence involving data preprocessing, deficiency identification, prediction modeling, and the development of surplus-exchange policies.

Preliminary results indicate significant nutrient deficiencies across age groups in Karnataka, with the potential for a 15% reduction in these deficiencies through targeted crop recommendations and inter-district nutrient exchanges. The nutrient exchange framework demonstrates an efficiency of over 85% in matching surpluses to deficits. Additionally, the 5-year production projections support agricultural planning by highlighting growth trends for key crops. These findings underscore the project’s ability to advance sustainable agriculture and nutrition, laying the groundwork for future enhancements such as real-time monitoring and AI-driven optimization systems.