ABSTRACT

Indonesia, a country with a strong agrarian base, is facing significant challenges due to rapid urbanization. With projections indicating that by 2045, around 70% of Indonesia's population will reside in urban areas, issues related to land availability and food security have become increasingly critical. In Surabaya, for example, data from 2021 shows that 81% of agricultural land consists of non-paddy fields. This reflects a shift towards urban farming methods, which offer a potential solution to the impacts of urbanization and ensure sustainable food supply. One such urban farming implementation in Surabaya is located on the rooftop of Telkom University Surabaya, equipped with soil sensors for real-time monitoring. Although these sensors provide valuable data, it has not yet been systematically analyzed to determine the most suitable crops for cultivation. This study aims to cluster soil condition data using the KMeans clustering method, with the goal of identifying data groups with similar characteristics and providing appropriate crop recommendations based on the clustering results. The data analyzed includes seven soil condition variables: nitrogen, phosphorus, potassium, pH, temperature, conductivity, and moisture. Clustering was performed on average daily data collected over a period of 74 days. The KMeans clustering method was applied to group the soil data into several clusters based on similarities in characteristics. The clustering results identified six distinct clusters, each with unique characteristics. Model evaluation was carried out using two primary methods: the Elbow method and the Silhouette Score. The evaluation results indicate that the optimal number of clusters is six. The decrease in Within-Cluster Sum of Squares (WCSS) was not significant after six clusters, while the silhouette score started to decline beyond six clusters, indicating that further cluster additions only provided minimal improvements in clustering quality. Each formed cluster displays similar soil conditions, characterized by high temperatures and low moisture, with slightly acidic pH levels. Additionally, there is variation in nitrogen, phosphorus, potassium, and conductivity levels across clusters. The cluster with the most data is C2, with 23 data points, while the cluster with the fewest data points is C4, containing only one data point. Based on this analysis, each cluster was assigned crop recommendations tailored to its soil conditions. For Cluster C0, which has slightly acidic pH, very high temperatures, and low moisture, crops such as beets, corn, and pumpkins are recommended, with an optimal planting period between May 25 and June 10. Cluster C1, with very fertile soil, slightly acidic pH, very high temperatures, and low moisture, is suitable for crops like okra and sweet potatoes, with a planting period from June 26 to July 29. Cluster C2, showing slightly acidic soil, high temperatures, and low moisture, is recommended for crops like long beans and eggplants, with an optimal period between April 23 and May 22. Cluster C3, with very poor soil fertility, very high temperatures, and very low moisture, is best suited for succulents, with a planting window from July 3 to July 5. Cluster C4, characterized by very fertile soil, slightly acidic pH, very high temperatures, and *low moisture, is recommended for okra and sweet potatoes, with a planting date of July 27. Finally, Cluster C5, which has slightly acidic pH, very high temperatures, and low moisture, is recommended for okra and sweet potatoes, with a planting period from June 11 to July 16. The findings of this study provide valuable insights into soil conditions in urban farming and offer more accurate crop recommendations based on data analysis. These results can be applied to other urban farming units in major cities, as well as in tropical countries, to enhance efficiency and yield. Implementing monitoring and analysis systems like this can help optimize urban land use, improve cultivation success, and support food security in increasingly urbanized environments. By adapting these research findings, urban farming managers can optimize their agricultural strategies, enhance cultivation success, and contribute to food security in the face of growing urbanization.*

***Keywords—** K-means Clustering, Harvest Optimization, Soil Condition Mapping, Soil Sensors, Urban Farming.*