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"Reconcile land system changes
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Urban and peri-urban agroforestry for climate change adaptation and ecosystem services provision in Kiambu, Kenya

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Abstract

Although urban and peri-urban areas occupy less than 2 % of the Earth's surface, they consume 78 % of global energy and generate over 60 % of greenhouse gas emissions. These areas are increasingly affected by climate change, facing risks such as rising temperatures, flooding, drought, and tropical diseases. This study examined Kiambu Sub-County, Kenya, with three objectives: to assess climate change and variability from 1990 to 2022, to evaluate changes in land use due to urbanisation, and to explore how urban and peri-urban agroforestry supports climate change adaptation and ecosystem service provision.The research was guided by a descriptive survey design. Climate data (rainfall and temperature) were sourced from the Kenya Meteorological Department, while land use and land cover changes were analysed using satellite imagery and maps. Primary data were collected through household and key informant interviews, questionnaires, on-farm observations, and transect walks. Both quantitative and descriptive techniques were used for data analysis, with results presented through graphs, tables, and charts. Rainfall analysis revealed high inter-annual variability without a significant trend (Sen's Slope: 3.09 $^{\text{mm}}/_{\text{year}}$; $p = 0.57$). In contrast, temperatures showed a statistically significant increase—maximum temperatures rose by 0.02°C/year, and minimum temperatures by 0.044°C/year. Land use analysis revealed rapid urbanisation: urban built-up areas increased by 119 %, and cultivated built-up zones by 25 %, while woodland and cultivated land declined by 37 % and 23 %, respectively. These changes were attributed to population growth and urban sprawl.

Agroforestry systems such as balcony gardens, multi-storey cropping, and played a crucial role in enhancing adaptive capacity and ecosystem resilience. Common systems included agrisilviculture and agrisilvopastoral, which provided multiple ecosystem services such as shade, improved air and water quality, food, timber, fruits, and fuelwood. A Shannon diversity index of 3.1487 reflected healthy species diversity and ecological stability.Urban and peri-urban agroforestry offers significant potential for climate change adaptation and ecosystem restoration in rapidly urbanizing areas like Kiambu. Despite its benefits, wider adoption is hindered by challenges such as limited access to quality seedlings and weak market linkages, which need to be addressed for sustainable scale-up.

Keywords: Agroforesry, climate change adaptation, ecosystem services, urban and peri-urban areas

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