



# Class dynamics and relationship between land-use systems and surface temperature in south-eastern Ghana

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## Abstract

A fifty-year study of land cover changes in Ghana's south-eastern region is conducted to identify major shifts and new avenues for justifiable growth and development. This study sought to assess the historical changes (1970–2020) associated with the region's land use systems, topography and land surface temperature. It further investigated the relationship between some given remotely sensed variables using autocorrelation and geoinformatics. Findings proved socio-political and economic factors have caused massive shift in land cover and prevailing climatic conditions through increasing settlements and migration, the extensiveness of agriculture, poverty, unregulated and unreported logging of trees, small-scale mining intensification, and weak governance systems. We discovered that the natural vegetation had dramatically reduced (– 52.01%), whilst built-up (+406.05%), farmlands/shrubs (+86.47%), and waterbodies (+47.35) were faced with a drastic increase. Class contribution rates show built environment massively influenced land modification, compared to other surveyed classes. In light of the major influences observed, it can be concluded that dynamics in land-use systems caused a substantial drift in local temperature. Temperature and built-up index correlated strongly ( $R^2=0.959$ ,  $p < .0001$ ), whilst depicting a negative association against vegetation ( $R^2=0.959$ ,  $p < .0001$ ) and water index ( $R^2=0.958$ ,  $p < .0001$ ). Variance assessment proved that the linear correlation model for the understudied elements is suitable. The study provides policy guidance amid sustainability concerns on streamlining land use activities in development planning and preservation of forests and river ecosystems that protect flora and fauna to enhance biodiversity and sustainable use of land and water resources.

**Keywords** Contribution rate · Volta River Basin · Driving forces · Land use · Slope analysis · Ghana

## Introduction

Like most developing countries, Ghana is making gains towards structural transformation; thus, moving from a raw to a well-industrialized economy. This extensive economic drive is catalyzed by increasing population, commercialization and extensiveness in agriculture, thereby amplifying the competition for essential resources like land. Competing interests among relevant stakeholders are tied to several needs, leading to the transformation of one form to the other. In simple terms, land use is classified as human activities, and the multifarious purposes which takes place on land. Land cover, on the other hand, entails pristine environments, man-made cover, among other features, observable over the

land. "Land Use Cover Change (LUCC)" is imbibed in two main components; thus, modification and conversion. As the name suggests, conversion involves changing one feature to another, whereas modification is maintenance of the broad cover while effecting changes to its attributes (Prakasam 2010). Land cover is more obvious to notice than land use, as the term denotes the surface cover over the land. Ellis and Pontius (2010) define land cover as "the physical and biological cover over the surface of land, including vegetation, water and bare soil." Some scientists delineate some man-made designs as "land cover." Conversely, different scientists have developed several meanings from "land use", considering its complexity. As explained by Prakasam (2010), the term could describe how land surface is used to sustain agricultural activities, forestry, and construction works, while social scientists define it as how the land is used essentially for socio-economic gains (Ellis and Pontius 2010).

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