vector population fluctuations. The findings will contribute to optimizing surveillance programs and tailoring control interventions according to seasonal patterns and habitat preferences of different mosquito species. Ultimately, understanding these ecological relationships is vital for mitigating the public health risks posed by mosquitoes in tropical regions under changing climatic conditions (Hinne et al., 2021; Blanco-Sierra et al., 2024).

2 Study Area and Ecological Background

2.1 Tropical climate characteristics and seasonal classification

Tropical regions are characterized by consistently high temperatures and significant humidity levels, creating an environment conducive to mosquito survival and reproduction. These climates typically exhibit distinct wet and dry seasons rather than the four-season pattern seen in temperate zones. The wet season, marked by heavy rainfall, increases the availability of aquatic habitats necessary for mosquito larval development, while the dry season often limits breeding sites but may still support mosquito populations in permanent water bodies or human-made containers. Temperature fluctuations within tropical climates also influence mosquito physiology and behavior, with warmer conditions generally accelerating development rates and increasing biting frequency (De Mello et al., 2022; Mazarire et al., 2024). Microclimatic variations caused by factors such as vegetation cover can further modulate local temperature and humidity, thereby affecting mosquito abundance and species distribution within tropical landscapes (Figure 1) (Abdullah et al., 2025).

Seasonal classification in tropical environments is often based on precipitation patterns, with the rainy season promoting peak mosquito activity due to increased habitat availability. However, temperature and humidity also play critical roles in shaping seasonal dynamics. For example, studies have shown that relative humidity above certain thresholds enhances adult mosquito survival, while temperature influences both larval development time and adult longevity. These climatic variables interact complexly to produce temporal fluctuations in mosquito populations that vary across different tropical ecosystems. Understanding these seasonal patterns is essential for predicting periods of heightened vector-borne disease risk and optimizing timing for control interventions (Chaiphongpachara et al., 2024; Arisanti et al., 2025).

Figure 1 Aerial view of non-dengue and dengue hotspots with GOS trap placement. The image presents an aerial view of the designated non-dengue hotspot (A) and dengue hotspot (B) within the study area. GOS (Gravid Oviposition Sticky) traps are strategically positioned across both sites to monitor Aedes mosquito populations. The spatial arrangement of traps provides comprehensive coverage, facilitating the study of mosquito activity and distribution patterns relative to environmental characteristics. This layout supports comparisons of Aedes species distribution and dengue virus prevalence between the two distinct ecological settings (Adopted from Abdullah et al., 2025)