Sustainable Agriculture Offers New Hope for Tackling Pakistan’s Smog Crisis

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Smog has emerged as one of Pakistan’s most severe environmental and public health challenges, repeatedly engulfing cities such as Lahore, Faisalabad, and Multan in dense haze during winter. While traffic emissions, industrial pollution, and urban expansion are widely acknowledged causes, scientific research is now revealing the crucial role agricultural landscapes play in shaping air quality.

Climate change has intensified the release and movement of gases from croplands, making agricultural fields an active component of both the smog cycle and greenhouse gas emissions. Rising temperatures, shifting rainfall patterns, and changing soil moisture levels influence how crops and soils emit gases such as methane, carbon dioxide, ammonia, and nitrogen oxides. These gases interact chemically in the atmosphere, particularly under warm and humid conditions, contributing to haze formation and long-term climate impacts.

To better understand these complex processes, scientists are turning to an advanced monitoring system known as the eddy covariance flux tower. Unlike conventional air-quality monitoring stations that only measure pollutant concentrations at fixed points, these towers directly capture real-time gas exchanges between croplands and the atmosphere. They track how emissions rise, mix, or return to the surface throughout the day, offering unprecedented insight into the role of agriculture in atmospheric chemistry.

Field-based observations in Pakistan’s agricultural belt show that smog is closely linked to seasonal crop residue burning, fertilizer application, irrigation events, and soil reactions following rainfall. Eddy covariance towers reveal that nitrogen oxide emissions can spike during hot afternoons or immediately after wet conditions—short-lived surges that traditional monitoring systems often fail to detect. By identifying the precise timing and conditions of these emissions, researchers can better understand how routine farming practices interact with weather patterns to intensify smog, particularly during harvesting seasons and extreme climate events.

Pakistan has only recently begun adopting this advanced atmospheric monitoring approach. Eddy covariance systems have been introduced through newly launched GCF-FAO-supported research initiatives and are currently installed at select locations, including the Central Cotton Research Institute (CCRI) Multan and the Muhammad Nawaz Sharif

University of Agriculture campus in Jalalpur Pirwala. These efforts are being led under the vision of Vice Chancellor Prof. Dr. Asif Ali, positioning Pakistan at the early stages of integrating agricultural science with climate and air quality research.

Rather than viewing smog as an isolated winter phenomenon, the new data reveal how everyday emissions from soils, crops, fertilizers, and surrounding activities gradually accumulate and react with seasonal weather changes to produce dense pollution. While smog will remain a challenge, eddy covariance technology provides Pakistan with a stronger scientific foundation for developing sustainable agriculture practices, improving air quality policies, and building long-term climate resilience.

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