Towards environmentally driven policies on sustainable agri-food systems: Estimating greenhouse emissions from road transportation in geographically- and agro-diverse Colombia

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**Resumen:**

Ensuring sustainable food systems requires governance to implement policies that protect food supplies for poor and vulnerable populations. To achieve this goal, transportation planners and policymakers must understand how food transportation affects the sustainability of food systems, especially in places that depend on fossil fuels and have fragile infrastructure. Poor transport infrastructure that lengthens travel distances, together with truck fleets composed of small trucks with limited load capacity, which increases the number of trips required, amplifies environmental impacts. This study quantifies greenhouse gas emissions (GHG) from the road transportation of three food crop groups in Colombia: vegetables, fruits, and tubers. Using official data on supply routes, road distances, and truck fleet composition, we estimate carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) emissions and evaluate the contribution of long distances and truck fleet composition to total emissions. In 2022, food transportation generated over 447,000 tons of CO2 equivalent, with vegetables accounting for the largest share of emissions. Replacing 2-axle trucks with higher-capacity and more fuel-efficient 3-axle vehicles, while holding transported volumes and routes constant, would reduce emissions by 36%, a reduction comparable to shortening the longest routes to the 90th percentile. These results provide one of the first estimates of the relative magnitude of spatial logistics factors and truck fleet technology in

determining food transport emissions in a middle-income country context. They also offer guidance for policy design aimed at developing more sustainable food systems while meeting food demand as poverty declines in developing countries.

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### 1. Introduction

Food systems are defined as an intricate interaction between a network of actors, activities, and processes, ranging from food production, marketing, to consumption and waste management, influenced by social, economic, political, and environmental factors—all the ingredients of a complex system...