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**Title: The Influence of Household Refrigerator Ownership on Sustainable Diets in Vietnam**



Refrigeration can have a transformative effect on diets, providing the capacity for people to consume perishable foods in larger quantities and with greater ease. Numerous studies show that as a country becomes more developed, there is an accompanying dietary shift from starchy staples to higher protein foods. However, there has not been much discussion about specific mechanisms that are necessary to enable these shifts, such as the presence of refrigeration. This study examines household refrigeration's role in catalyzing the dietary transitions associated with greater levels of development.

Household refrigerator ownership in Vietnam is growing, increasing from 13% in 2004 to 59% in 2014. Dietary shifts prompted by refrigeration have implications for sustainable development by influencing nutrition and the environmental impacts of food systems. Our study estimates changes in per capita calorie consumption per day and corresponding food greenhouse gas (GHG) emissions associated with household refrigerator ownership in Vietnam. Data from the Vietnam Household Living Standards Survey (2004-2014) on refrigerator ownership, daily diet, and socioeconomic controls are examined using a GAMLSS regression model.

We find refrigerator ownership to be associated with a 135 Kcal/day/adult-equivalent decrease in starchy staple foods consumption, a 12 Kcal increase in meat consumption, and a 3 Kcal increase in dairy consumption for the average household at a statistically significant level ( $p < 0.001$ ).

Our study finds no significant relationship is found between refrigerator ownership the consumption of fruits and vegetables, traditionally purchased from informal vendors at frequent intervals. GHG impacts of these shifts are characterized using emissions factors from the life cycle assessment literature. Modeling these dietary shifts for an average household without a refrigerator results in a GHG emissions decrease of 0.16 kg CO<sub>2</sub>e/day/adult-equivalent, with increases from meat and dairy offset by the larger decrease in starchy staple food consumption. The changes in food type consumption associated with refrigerator ownership likely correspond to the technological role refrigerators play: increasing the capacity to store and consume perishable foods, which in turn facilitates shifts away from decreases the starchy staple foods in consumer diets. The broader nutritional and environmental implications of these shifts will be discussed.