

Global Patterns in Human Appropriation of Net Primary Production: Assessing NPP Supply and Demand Using Earth Observation Satellites and Statistical Data

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A unique combination of satellite and socio-economic data were used to explore the relationship between human consumption and the carbon cycle. Biophysical models were applied to consumption data to estimate the annual amount of Earth's terrestrial net primary production humans require for food, fiber and fuel using the same modeling architecture as satellite-supported NPP measurements. The amount of Earth's NPP required to support human activities is a powerful measure of the aggregate human impacts on the biosphere and indicator of societal vulnerability to climate change. Equations were developed estimating the amount of landscape-level NPP required to generate all the products consumed by 230 countries including; vegetal foods, meat, milk, eggs, wood, fuel-wood, paper and fiber. The amount of NPP required was calculated on a per capita basis and projected onto a global map of population to create a spatially explicit map of NPP-carbon 'demand' in units of elemental carbon. NPP demand was compared to a map of Earth's average annual net primary production or 'supply' created using 17 years (1982-1998) of AVHRR vegetation index to produce a geographically accurate balance sheet of NPP-carbon 'supply' and 'demand' for the globe. Globally, humans consume 20% of Earth's total net primary production on land. Regionally the NPP-carbon balance percentage varies from 6% to over 70% and locally from near 0% to over 30,000% in major urban areas. The uneven distribution of NPP-carbon supply and demand, indicate the degree to which various human populations rely on NPP 'imports', are vulnerable to climate change and suggest policy options for slowing future growth in NPP demand.