Ecosystem services in hinterlands: How cities connect to their resource bases

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Abstract

Nearly all of the wild lands of the planet have been exploited, either actively or passively, to produce ecosystem services (ES); this is especially true in the heavily managed and resource-rich areas close to major cities. These areas, referred to as hinterlands, have served the important role throughout history of supplying a suite of ES needed to satiate the demand for ES in their neighboring city. Yet globalization has resulted in highly specialized ES production in hinterlands, possibly resulting in inequitable sharing of the burden to supply ES globally. To date, global ES models have not done a good job of describing how hinterlands around the world are used to provide ES, or how the interactions between multiple ES change in different areas of the planet. There is also a poor understanding of the mechanisms that cause hinterlands to specialize their ES production into distinct ES bundles; is it simply because they are biophysically more suitable to produce certain services or is there more to it than that?

We use globally available spatial datasets and models to produce maps of ES supply for 8 ES; 3 provisioning (crop, livestock, water), 4 regulating (carbon sequestration, carbon storage, air quality, water quality), and 1 cultural (nature recreation). We examine how these ES are produced in the hinterlands of all cities with populations greater than 500 000 (n=768). We use an affinity propagation clustering algorithm to group hinterlands into similar ES bundles, and then apply a multinomial logit model to test the effects of biophysical and socio-economic variables in determining which bundle a hinterland will fall into.

We find that hinterlands cluster into 7 different ES bundles. Notably, hinterlands in India and China that are used mainly for food production at the expense of other ES are respectively identified as distinct bundles from the global hinterland. We also find a distinct bundle of ES that forms at extremely high levels of wealth featuring mainly regulating services. We find that, with the exception of precipitation, biophysical variables explain very little about which ES will be produced in hinterlands. Instead, the amount of urban sprawl has a much greater effect. We also find that levels of wealth significantly contribute to which ES will be provided, though it is unclear if this is a cause, an effect, or both. Wealth was positively correlated with all regulating ES and negatively correlated with all provisioning ES, potentially suggesting that we are undermining the long-term resilience of the worlds most poor.

Keywords: ecosystem services, global, urban, bundle

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