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Energy and the agroeconomic complexity of Ethiopia

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Since the Industrial Revolution, modern agriculture has transformed from a net energy supplier to a net energy user, via the extensive use fossil fuels –that substituted solar energy inputs- and petroleum derivative products (fertilizers) (Pimentel and Pimentel 2008; Woods et al. 2010). This condenses a significant overview of agricultural energetics, especially for economies set on their first stage of development, growth and economic diversification, such as Ethiopia. Ethiopia is the Blue Nile's most upstream country, constituting a very sensitive hydroclimatic area. Since 2008, Ethiopian agriculture experiences a boost in energy use and agricultural value-added per worker, due to the rapid introduction of oil-fueled agricultural machinery that increased productivity and allowed crop diversification. Agriculture in Ethiopia accounts for ∼82% of its total exports, ∼45% of its Gross Domestic Product (GDP) and ∼75% of its total labor force. In addition, Ethiopia's agricultural sector is equipped with a set of new financial tools to deal with hydroclimatic extremes, like the 1983-85 droughts that deteriorated its crop output, causing a devastating famine. In fact, Ethiopia's resilience from the (most) recent drought (2015-16) has been remarkable. These facts signify that Ethiopia satisfies the necessary conditions to become a regional agritrade gravity center in the Blue Nile, granted that the dispersion of agricultural trade comprises a primary tool for securing food supply. As gravity equations have been used to model global trade webs (Tinbergen 1962), similar principles may apply to agritrade as well, for identifying emergent topological structures and supply chains. By examining the relation between energy inputs in agriculture with crop diversification and value-added chains of Ethiopia's agritrade, we could extract accurate information on the importance of energy for the country's agroeconomic complexity and regionalization trend across its first stages of development. Via the use of entropy we may identify patterns of agritrade agglomeration or dispersal; alternatively study the continuity or fragmentation of Ethiopia's agritrade gravity field. Agglomeration towards Ethiopian agricultural supply would indicate the upgrade of the country's supply stability and -therefore- importance in the global agritrade web.

Keywords: Industrial Revolution, net energy, diversification, Blue Nile, hydroclimatic extremes, agritrade, gravity, value-added, complexity, regionalization, entropy

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