2022

IARIW-TNBS Conference on "Measuring Income, Wealth and Well-being in Africa"

Trying to see the forest for the trees: Forest cover and economic activity in Africa

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Mutual relationships between the natural environment, economy and society are complex and include both virtuous and vicious circles. Forests and forest products play an important role in economies of many countries, especially developing ones. It was estimated that about 20% of rural income comes from forests, and for some countries it is the only source of income (Hogarth et al., 2013). Therefore, many countries experience overharvesting which, especially coupled with a greater demand for arable land, often leads to deforestation.

Deforestation remains one of major environmental problems all over the world. It is usually discussed in the context of carbon capture and sequestration as well as biodiversity conservation. The outbreak of the COVID-19 pandemic in 2020 and Ebola in 2021 brought about a new wave of interest in this problem due to the fact that deforestation occurring in tropical forest significantly increases the risk of proliferation of infectious zoonotic diseases.

Importantly, introduction of lockdown measures in response to COVID-19 pandemic affected governments' capacity to control for illegal deforestation, and resulted in instantaneous increase of tropical deforestation. Over the first weeks following the implementation of confinement measures to reduce the spread of COVID-19 disease, deforestation increased by 63% in America and Asia-Pacific, and by as much as 136% in Africa (Brancalion et al., 2020).

Over the past decades, forest cover in the vast majority of African countries has decreased (Moon, Solomon, 2018). As a matter of fact, during 2010-2020 Africa was the continent experiencing the largest annual rate of net forest loss, equal to 3.9 million hectares per year (FAO, 2020). According to FAO estimations, only Algeria, Tunisia, Eswatini and Cabo Verde observed an opposite trend, while the developments of forest cover in Burundi and Rwanda bear signs of forest transition, which means switching from net forest area loss to net gain.

The literature discussing the process of deforestation and forest transition is very rich. In the African context, there are many articles focusing on particular countries or regions of Africa, such as Central Africa (Zhang et al., 2005), Nigeria (Olowoyeye, 2021), Democratic Republic of Congo (Godoy, Vitekere, Lango, 2020) or Ethiopia (Birhane, Alebachew, Kim, 2020). However, there are not many Africa-wide studies on deforestation, with the exception of Semazzi & Song (2001), Subedi et al. (2014) and Yalew (2015).

The links between the forest cover and economic activity are usually discussed with reference to the concept of the environmental Kuznets' curve. Accordingly, since publications by Grossman & Krueger (1991) and Shafik & Bandyopadhyay (1992) the hypothesis that there is an inverted U-shaped relationship between indicators of environmental degradation and economic growth has been the subject of many empirical investigations. Deforestation is treated as one of the manifestations of environmental degradation (e.g. Koop & Tole, 1999; Włodarczyk, 2010). Bhattarai & Hammig (2001) show strong evidence of an environmental Kuznets' curve relationship between income and deforestation for Latin America, Africa and Asia. It asserted that in developing countries from Latin America and Africa the inverted U shaped of the curve implies that current level of economic development is not adequate to protect the forests from deforestation (Culas, 2012).

In principle, the environmental Kuznets' curve is an empirical phenomenon, but most of the literature discussing cause-and-effect relationships is econometrically weak (Stern, 2004). Spurious correlations can be attributed to the fact that emissions of most pollutants and flows of waste tend to rise with income, but income-independent, time-related effects reduce their environmental impact at all levels of income (Stern, 2004).

Researchers also come up with contradicting conclusions with reference to the link between deforestation and population growth. Rapid growth of human population has often been identified as one of the main factors of environmental degradation (Asongu & Jingwa, 2012). Increase in population increases demand for agricultural products and hence for agricultural land which induces forest clearance (Barnes, 1990). Asongu & Jingwa (2012) concluded that forest exploitation instruments do not explain the changes taking place in forest areas and agricultural land. Therefore, they recognized population growth as the main driver of deforestation in Africa. Yalew (2015) also came to similar conclusions but with reference to Sub-Saharan Africa. Also, Ryna et al. (2016) claim that national population level change was the biggest driver of forest loss rate in Albertine Rift. African Union Commision (2019) points out that the rapid population growth has increased the pressure on forest resources. Moreover, many authors point to a large correlation between population growth and increased deforestation in individual countries (cf. Clark, 2012; Epule, 2014; Dabel et al., 2014; Tchatchou et al., 2015).

The aim of the article is to contribute to the existing literature and to discuss the environmental Kuznets' curve hypothesis for African countries in a new context. Firstly, we investigate the relationship between GDP per capita or urban population (as percent of total) and the percentage of forest land for the period 1990-2020. Secondly, increased data availability allows us also to resort to satellite data showing the relationship between the probability of covering the area with forest, trees and shrubs (according to Copernicus Global Land Service, Land Cover 100m for 2017-2019) and maps of night sky illumination (according Global Nighttime Lights by NOAA National Centers for Environmental Information) which are GDP equivalent. Furthermore, we make an attempt to conduct the so-called Optimized Hot Spot Analysis which is a method based on Hot Spot Analysis proposed by Getis & Ord (1992). Each point on the map is analyzed in the context of neighboring objects. We assess whether observed relationships are a result of real spatial processes or have random character with real spatial processes are understood as locations characterized by high values of spatial autocorrelation (Moran's I). Therefore, apart from the scope of analysis, the novelty of the research consists in the datasets and methods applied.