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Quantifying the impact of industrialization on blue carbon storage in the coastal area of Metropolitan Semarang, Indonesia

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Quantifying the impact of industrialization on blue carbon storage in the coastal area of Metropolitan Semarang, Indonesia

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QGIS Dzetsaka tools

ABSTRACT

This study investigated the impact of the coastal industrialization policy which began in 2015 in Indonesia. Because this policy has effected physical change on the environment, it requires quantification to determine its driving factors, and to formulate solutions to its problems. In doing so, this research used remote sensing and machine learning techniques. Satellite data from Sentinel-2A were acquired for the years 2015 and 2019 for LULC model, and Landsat 8 OLI for industrial growth model in coastal area. The data were processed using QGIS 3.8 software with machine learning techniques, the Random Forest algorithm, and sci-kit learn library from Dzetsaka tools. The results showed that changes in land use and land cover areas significantly contributed to the loss of blue carbon storage of more than 20%. This finding confirms that the industrialization policy on the coastal area needs to be reviewed, and land use monitoring must be more strictly regulated.

1. Introduction

Globally, coastal ecosystems face enormous anthropogenic pressures, such as urbanization and industrialization, which impact the intensity of land use/land cover (LULC) and change the coastal landscape (Handayani et al., 2017; Hansen, 2010; Hurlimann et al., 2014; Pendleton et al., 2012). The variation and density of coastal area activities is evidenced by the presence of almost half of the world's urban population moving closer towards them (Buchori & Tanjung, 2013; He et al., 2014; Sejati et al., 2020). Their high degree of appeal lies in coastal ecosystems providing access to trade, food production, easy land development, and valuable ecosystem services. These are the main reasons why cities growing in coastal areas have a higher per capita income than landlocked ones (Gallup et al., 1998). To overcome some of the impacts of the intensity of the coastal spatial policy which contribute to global warming, in 2015 the IPCC launched several movements on climate change, carbon emissions, and surface urban heat, especially in coastal areas (Buchori et al., 2018a, 2018b). The agreement focuses on changes in coastal LULC, to effect a reduction in the type of land use that can improve carbon emissions and lower surface temperatures (Sejati et al., 2019). In addition, all countries should maintain temperature rises of no more than 1.5 °C, especially in regions affected by climate change, such as coastal areas (IPCC, 2018).

An equally crucial global issue is the reduction of wetlands in countries with a global influence on supporting blue carbon storage (BCS) (Meng et al., 2019). BCS is carbon that is absorbed and stored in coastal and marine ecosystems, such as mangrove, seagrass, brackish swamp, and phytoplankton ecosystems. The existence of BCS is largely influenced by the coastal landscape, such as land cover and the dynamics of coastal activities (Ahmed et al., 2017; Ahmed & Glaser, 2016; Pendleton et al., 2012). With extensive development activities significantly affecting land cover, continued utilization of land at the coast has converted the functions of wetland and other coastal ecosystems, and thus affected the amount of BCS (Ahmed et al., 2017; Kaal et al., 2019; Lewis et al., 2019; Ma et al., 2019; Thorhaug et al., 2017, 2019). Therefore changes in the coastal landscape can have a significant influence on BCS.

Previous studies have explained how urban development in coastal areas can reduce the quality of the coastal environment and cause biodiversity loss, especially in major coastal cities. In the future, predictions of the number of large cities growing on the coast will continue to rise, with the highest concentration being in Asia. In the Indonesian

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Poverty trends in villages affected by land-based investments in rural Laos

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Keywords:
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ABSTRACT

This paper contributes to debates on the implications of land-based investments on local livelihoods in the Global South. Drawing on a comprehensive national dataset on land concessions in Laos, and 2005 and 2015 village-level poverty rates, we examine the association between land-based investments and poverty at the village level in Lao rural areas. Results outline contexts in which land-based investments have either positive or adverse association with village-level poverty change rates; they also reveal factors that determine village-level poverty reduction in Laos. Our results suggest that poverty rates in villages affected by land-based investments decreased significantly between 2005 and 2015, following the national trend in Laos. However, in cases where land-based investments caused more farmland loss, poverty reduction was low or poverty rates increased over this period. Results further reveal that land-based investments implemented in more remote areas or poorer villages had a stronger association with poverty reduction. However, poverty was not a central consideration for the establishment of land-based investments. Our findings fill an important gap, providing a middle-level analysis from which grounded observations are analyzed alongside national trends.

1. Introduction

The dramatic increase in land-based investments[1] for agricultural production in the Global South since the 2000s has become a global concern, particularly due to the adverse impacts on local environments and livelihoods. A range of global drivers triggered these investments (Zoomers, 2010), while host government policies directly or indirectly facilitated them by providing tax incentives, zoning land specifically for investment, and mediating land conflicts with communities (Cotula, Vermeulen, Leonard, & Keeley, 2009; Margulis, Mckeon, & Borras Jr, 2013). In addition, the World Bank championed agricultural land-based investments, claiming that large areas of arable land in developing countries, referred to as "idle land," was unproductive, inefficiently used, or underutilized (Hall, 2011; White, Borras Jr, Hall, Scoones, & Wolford, 2012). In this view, granting land in marginal areas to investors could boost agricultural productivity and alleviate poverty in rural areas of the Global South (Colchester et al., 2013; White et al., 2012; Borras Jr, Fig, & Suarez, 2011). While proponents anticipate off-farm employment opportunities and spillover effects such as infrastructure or market access (von Braun & Meinzen-Dick, 2009; Deininger et al., 2011; Mirza, Speller, & Dixie, 2014), land-based investments often compete with smallholders for farmland and associated resources. This may challenge local livelihoods or increase vulnerability (Daniel, 2011; Rulli & D'Odorico, 2014; White et al., 2012; Zaehringer, Atumane, Berger, & Eckert, 2018). In addition, most rural land is already in use for agricultural production or ecosystem services that are essential to smallholder livelihoods (Hilhorst & Zoomers, 2012; McMichael, 2012; Zoomers & Kaag, 2014). The categorization of land as idle "often reflect[s] an assessment of the productivity rather than existence of resource uses: these terms are often applied not to unoccupied lands, but to lands used in ways that are not perceived as "productive" by government" (Cotula et al., 2009, p. 62). Critics, therefore, see land-based investments as a way that transnational investors from capital rich countries rush to control farmland and associated resources in developing countries for export-oriented food and non-food commodity production, rather than local development opportunities (Borras Jr & Franco, 2012; De Schutter, 2011; Hall, 2013); this is known as "land grabbing" (Borras Jr, Hall, Scoones, White, & Wolford, 2011).

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[1] Throughout the paper, the terms "land-based investment" and "deal" are used interchangeably.

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Changes in anthropogenic influence on soils across Europe 1990–2018

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ABSTRACT

Soils have been widely transformed and degraded by human activities. The area occupied by soils that remain unmodified is decreasing, while recent rural outmigration and land abandonment provide new opportunities for soil restauration across larger area.Little is known about the spatial distribution of both near-natural and anthropogenically influenced soils on large scales. We here present a new methodology to assess soil naturalness across Europe combining CORINE land cover and anthropogenic diagnostic features of the World Reference Base (WRB) for soils. Based on these features, we defined soil naturalness groups, ranging from dominantly natural to dominantly anthropogenic soils. This yielded a European soil naturalness map for the year 2018, covering 37 countries. Using the dataset resurveys, we spatially assessed changes in land cover in 1990–2018 and used these to estimate changes in soil naturalness. On average, 50.74% of the examined soil surface was classified as natural or near-natural, 41.66% of the surface was moderately, but recognizably transformed by human activities, while 4.43% of the soils were found to be strongly affected or created by human activities. Over the study period, increased anthropogenic influence on soils was stated for 42 745 km^2 (0.18% of the surface studied area), decreasing influence for 14 248 km^2 (0.06%). Hotspots of increasing anthropogenic influence were found in regions with rapid development, while hotspots of decreasing influence were often associated with land abandonment.Our approach allows recognizing areas of changes in soil naturalness, and can be used to inform soil protection initiatives on the European level.

1. Introduction

Soils play an important role in ecosystem functioning. They provide provisioning ecosystem services such as water retention, regulating services such as carbon sequestration and provisioning services such as nutrient cycling or habitat provision (Adhikari & Hartemink, 2016). Soils serve as archives of the customs and activities of humans over history and thus also provide cultural services (Yaalon & Arnold, 2000).

Despite the importance of soils for the persistence of ecosystems and humanity, soils have been widely transformed and degraded. Since the emergence of the first settlements and the expansion of soil cultivation, human activities constitute an important soil forming factor (Dudal, 2005). Soils are affected by various anthropogenic influences (AI) across extensive areas (Mendyk et al., 2016). This is mirrored in their taxonomy (Waroszewski et al., 2015; Świtoniak et al., 2016). We here consider anthropogenic impacts all local or distant human activities that change (directly or indirectly) measurable and detectable properties of soils. However, it is not possible to reflect all anthropogenic impacts in the soil taxonomical status.

The area occupied by soils that remain unaffected by AI is decreasing. By 1990, ca. 15% of the world's soils were in some way degraded (Oldeman, 1992, pp. 19–36), more recently, figures of up to 33% have been suggested (Nachtergaele at al. 2011). Current rates of erosion on agricultural land are an order of magnitude higher than that of natural erosion or soil formation processes (Ter, 2012). The main factors that induce soil transformation are deforestation (Sewerniak et al., 2017), drainage (Glina et al., 2016), soil sealing (Mendyk & Charzyński, 2016), construction, mining, and agricultural cultivation (Szilassi et al., 2010).

Amelioration and landfill with excavated material affect a considerable area every year (Dazzi & Lo Papa, 2015; Dudal, 2005).

Soil naturalness (Bossuyt et al., 1999) is an important feature in soil taxonomy, where pedogenic features are related to natural soil forming factors as principal criteria in the classification process (IUSS WG IUSS Working Group WRB, 2015). Anthropogenic soil features are considered unambiguous indicators (Certini & Scalenghe, 2011) of the

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