Sustainable Development and Mangroves

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Mangroves are salt-tolerant trees that inhabit the mid and upper intertidal coastal fringes (mainly estuaries and deltas) of tropical and subtropical regions. Rainfall, tidal height, salinity, soil characteristics (nutrients and oxygen content, grain composition and humidity), and biotic factors, like herbivory, are among the main ecological factors determinant of their development, diversity, and high biomass .

conservation sustainable development

1. Introduction

Today, the Earth is going through a critical moment of social–ecological challenges. Centuries of industrial development and natural resources overexploitation are turning out to be a heavy burden for the planet[1][2][3]. Impacts shift from local to global: the global climate is being altered and life supporting ecosystems (LSEs) continue to collapse, causing countless species to go extinct. Cattle breeding and harmful agricultural practices are destroying soils and increasing greenhouse gas (GHG) emissions, bringing the biosphere close to the threshold of a state shift of adverse conditions, or even of collapse[4][5][6] . In 2011, the world's richest 500 million people were producing half of the world's GHG emissions, whereas the poorest three billion were emitting just 7% [7]. Additionally, while the richest one fifth of the human population earns 74% of the world's income, having far more than their basic needs in terms of food security and welfare, another one fifth earns just 2% of the global income and lack access to water, food, and basic services[8][9][10][11][12][13][14][15]. Around one billion people suffer from chronic hunger [8][9][10] while global food production is already sufficient for all, but is unevenly distributed [11][12][13] . Using evermore limited natural resources, the human-made mass of inanimate objects equals the biomass of the overall global mass of all living taxa, including humans and their livestock [14].

Since their popularization by the the Common Future Report in 1987 [15], "sustainable development", "sustainability", and other similar terms, mainly referring to an economic development without depletion of natural resources and their ecosystem services, have been used as mantras both in research and in policy. The approach assumes that "green" consumption and environmental-friendly technology, which would, in turn, lead to the sustainable development, i.e., growth of national economies, could be solutions to the social-ecological crises that humanity faces [16]. In the sustainable development framework, natural resources would be able to continuously support economic growth of "developed" as well as "developing" countries. "Sustainable" large-scale agriculture and factory farming would warrant food for all present and future generations. The "Sustainable Development Goals" adopted by the UN fail to avoid, and to some extent even promote [17], environmental degradation.

Overexploitation of the planet, claimed by the elites and the governments that they control as absolutely necessary to bring about human well-being, has not solved hunger and other pressing socio-economic issues.

Despite criticism, countless research and conservation projects struggle to make the SDGs at least minimally efficient in tackling these problems while maximally conforming to economic growth, in an “adapting the problem to the solution” fashion. In the meantime, the grabbing and privatization of natural resources [18][19] and the socialization of environmental damages [20] were watched. Under the “sustainable development” tinkering pragmatism, which has been extensively proven to be unable to avoid the exhaustion of diverse environmental goods and services, dreaded “business as usual” scenarios continue to unshakably rule over the anxiously-desired-but-yet-delusional, “capital-friendly” alternative paths. These findings are not new, and neither are the solutions, nor the urgency of the problems at hand. As such, the paradigm of “sustainable development” crashed against an unquestionable truth: it is not possible to reach human equality and stop the overexploitation and consequent degradation of nature in economic systems or modes of production whose soul is permanent growth, increased consumerism and inequality, and wealth accumulation [16][21][22]. Indeed, humanity (but mainly rich countries) is consuming more than the can replace, and this clear truth constitutes the background of the approach: no planetary net economic growth can be ecologically sustainable[1][10][16][23].

Countless ecosystems have suffered fragmentation and degradation, and among them, wetlands are highly affected. Coastal wetlands are extremely important LSEs, removing carbon dioxide from the atmosphere and sequestering it in long-term carbon sinks, as plant biomass and soil refractory carbon compounds, and providing important climate adaptation and resilience services [24]. Beyond the threats of global warming (rainfall shortage, increase in temperature, and sea level rise) coastal wetlands face encroachment, intense exploitation, changes in hydrology, and pollution [25] .Over 60% of the world coastal wetlands have been lost in the last century [26].

2. Protecting, Conserving, and Restoring Mangroves

Among these wetlands, mangrove forests are some of the most important ecosystems, with a high provision of goods and services in relation to their extension[27][28][29][30][31][32][33][34] . Mangroves are salt-tolerant trees that inhabit the mid and upper intertidal coastal fringes (mainly estuaries and deltas) of tropical and subtropical regions [35][36]. Rainfall, tidal height, salinity, soil characteristics (nutrients and oxygen content, grain composition, and humidity), and biotic factors, like herbivory, are among the main ecological factors determinant of their development, diversity and high biomass [36][37]. On a global scale, Indo-West Pacific mangroves, with around 40 tree species, have around six times more species than the Atlantic Caribbean-East Pacific mangroves (7 species) [35]. Their position between land and sea has made them especially vulnerable to clearing and conversion into infrastructural enterprises, aquaculture ponds, salt works, cattle breeding areas, and human settlements[38][39][40] . Total mangrove ecosystem carbon stocks (vegetal biomass and soil) can reach an average of 856 ± 32 MgC/ha, approximately 11.7 PgC globally [41], which is more than 2.3 times the yearly carbon emissions of the USA in 2018 [42]. For these reasons, their conservation and eventual restoration can keep a huge amount of carbon locked in the ecosystem, which would accelerate atmospheric warming if released.

However, despite a slight reduction in forest loss rates, mainly in the Americas, Africa, and Australia[43][44][45][46], mangrove clearing and fragmentation continues, especially in Southeast Asia[43][44][45] . Worse yet, recent research highlights widespread indirect impacts, which result in a reduction of ecosystem services, and in the resistance and resilience to environmental impacts [20]. Necessary ample reforestation programs have not been implemented, although conservation of these forests should motivate supranational efforts. The opportunities of mangrove restoration are many, and their restoration is possible and strategic to stop the “economically and socially illogical” destruction of these forests. In the last four decades, only around 2,000 km^2 of mangroves have been restored. However, 8,120 km^2 of lost mangroves worldwide are yet restorable, and, if they were rehabilitated, 69 million tons of atmospheric carbon could be sequestered (equivalent to the annual emissions of 25 million American homes), also enhancing small-scale fisheries and increasing coastal protection [47].

The arguments presented find support in existing scientific and economic literature, expert-based approaches, and articles from renowned sources. Recent history has shown that the use of mangroves has not been and cannot ever be “sustainable” under the current developmentalist, capital-oriented economic system. The recent privatization trend has led to unjust and unsustainable resource allocation [48], conflicts around access and use, lack of compliance with management regulations [49], and, in some cases, even the complete loss of the privatized wetlands[50] . The threats posed by the current development and exploitation paradigm over mangroves is one part of the same threat to all biosphere ecosystems, but there are paths to slow down and hopefully reverse the collapse of these unique LSEs and of the biosphere itself. All viable paths, however, necessarily involve a worldwide overcoming of the capitalist (i.e. every capital accumulation & nature predatory aimed) mode of production and of sociability into one where economic growth and capital accumulation are no longer an imperative. Solutions are still to be collectively built and, despite the perspective of struggles and mistakes along the way, all challenges are worth facing when imminent global disaster were confronted with.

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