JOURNAL OF WORLD-SYSTEMS RESEARCH

ISSN: 1076-156X | Vol. 31 Issue 2 | DOI 10.5195/JWSR.2025.1315 | jwsr.pitt.edu

Global Capital and Amphibian Extinctions

Ecologically Unequal Exchange with Colonial and Neocolonial Sri Lanka

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Abstract

Sri Lanka has the highest number of recorded amphibian extinctions and most of the island's remaining amphibian species are threatened with extinction. From a critical political-economic perspective that integrates previously disconnected lines of analysis in herpetological conservation, development, land use change, and colonial and neocolonial histories, we argue that these extinctions and extinction risks should not be understood as a localized event, but, instead, in relation to global networks that emerged from the international development of capitalism. Mass deforestation of the Southern Highlands, the region of Sri Lanka with the highest diversity of endemic and endangered amphibians, began following the commodification of land to establish plantations under British colonial rule. The core-periphery power relations installed during colonization remain in the neocolonial period, undergirding the forces driving deforestation to this day. Higher-income countries and multinational corporations have financially benefited from Sri Lanka's "development" at the expense of many Sri Lankans and the island's diverse amphibian populations and their habitats, a relationship consistent with the theory of ecologically unequal exchange.

Keywords: Biodiversity Loss; Amphibian Declines; Deforestation; World-Systems Theory; Dependency Theory; Capitalism

We are in the midst of a global biodiversity crisis with unprecedented extinction rates driven by human activities, sometimes referred to as the sixth mass extinction (Barnosky, et al. 2011; Ceballos et al. 2015; Ceballos, Ehrlich, and Dirzo 2017). According to Dirzo and colleagues (2014: 401), "[o]f a conservatively estimated 5 million to 9 million animal species on the planet, we are likely losing ~11,000 to 58,000 species annually," a figure that excludes extirpations, population declines, and extinction risks. Nearly 200 vertebrate species are estimated to have gone extinct in the past century, a conservative figure that is even more alarming when compared to the "background" extinction rate over the past 2 million years, when, depending on the taxa in question, it may take up to 10,000 years for 200 vertebrate species to go extinct (Ceballos et al. 2017).

Among vertebrates, amphibians have the highest percentage of assessed species threatened with extinction (~41 percent) (Luedtke, et al. 2023; Re:wild, Synchronicity Earth, and IUCN SSC Amphibian Specialist Group 2023). The possibility that amphibian population declines and extinction risks may be a global problem was initially noticed during the first World Congress of Herpetology in 1989, leading to a number of studies validating and deepening this concern (Barinaga 1990; Wake 1991; Alford and Richards 1999; Houlahan, et al. 2000; Alford, Dixon, and Pechmann 2001; Stuart, et al. 2004; for histories, see Collins and Crump 2009; Green, et al. 2020). Research has identified major proximate causes of declines and extinction risks, with common culprits being habitat loss and degradation, climate change, pollution, infectious disease, commercial overexploitation, and invasive species (Blaustein and Kiesecker 2002; Collins and Storfer 2003; Collins 2010; Beebee and Griffiths 2005; Sodhi, et al. 2008; Campbell Grant, Miller, and Muths 2020).

While more is known about the *proximate* causes of amphibian declines and extinction risks over the past few decades, less is known about *underlying* social causes (Gunderson, Stuart, and Petersen 2025; for overlapping approach to "proximate" and "underlying" causes, see Geist and Lambin 2002). Here, by "underlying" causes we mean "deeper" social-structural and political-economic drivers that often go unnoticed. Below, we focus on how the basic processes of capitalism (underlying causes) drive habitat loss (the primary proximate cause of amphibian declines in Sri Lanka). Capitalism is typically overlooked and often taken for granted as a "social gravity" (York and Clark 2006)—always present but rarely reflected on—despite its substantial impacts on social and ecological life. Previous research has examined the structural drivers of animal species declines and extinction risks (e.g., Czech 2000; Naidoo and Adamowicz 2001; Hoffmann 2004; Clausen and York 2008; Czech, Mills Busa, and Brown 2012; Lynch, Long, and Stretesky 2015, 2019; Sol 2019; Stuart and Gunderson 2020; Pouteau, et al. 2022), finding that GDP growth is often associated with species declines, including amphibians, and biodiversity loss in general (e.g., Naidoo and Adamowicz 2001; Sol 2019; Habibullah, et al. 2022; Pouteau, et al. 2022).

The goal of this paper is to examine some of the specific mechanisms behind the correlation between capitalist forms of economic "development," often measured by GDP growth, and biodiversity loss and species extinctions. To do so, we provide a detailed historical case study of

the social-structural drivers of amphibian extinction risks and extinctions in Sri Lanka. The analysis offers more in-depth knowledge into the specific political-economic processes that drive species extinctions and extinction risks that can be missed in aggregate studies of economic growth's impact on biodiversity.

Sri Lanka is an illustrative case study in amphibian declines both due to the commonalities it shares with many other regions experiencing amphibian extinction risks as well as the severity of this problem on the island. Sri Lanka leads the world in recorded amphibian extinctions and has a high percentage of threatened amphibian species. Although a distinct case study with a particular history, amphibian declines in Sri Lanka are also representative of global amphibian declines in that habitat loss, the leading proximate driver of amphibian declines globally (Collins and Crump 2009; Green, et al. 2020; Re:wild, et al. 2023), is the also the leading driver of declines in Sri Lanka (Meegaskumbura, et al. 2002; Meegaskumbura, et al. 2007; Surasinghe 2009; Erdelen 2012; Batuwita, et al. 2019; Re:wild, et al. 2023).

This is a "theoretical" project in the sense of social theories offering "an original 'interpretation,' 'reading,' or 'way of making sense' of a certain slice of the empirical world," thereby shedding "new light on an empirical problem" (Abend 2008: 178). Methodologically speaking, we create this original "way of making sense" through an integration of formerly disparate lines of analysis—combining ecological research on amphibian extinctions and extinction risks, historical accounts of colonial and neocolonial international relations, and studies of deforestation drivers—interpreted through the lens of the critical political-economic tradition. Specifically, we approach this as a historical case study, drawing on secondary historical literature, ecological datasets, and conservation assessments to trace the social-ecological processes shaping amphibian declines in Sri Lanka. By situating ecological patterns within social structures, and vice versa, this approach highlights how local biodiversity loss is embedded in global systems of inequality and exploitation.

In what follows, we provide an overview of the problem of amphibian extinction risks and extinctions in Sri Lanka. Following, we summarize insights from critical approaches to global political economy and development that guide our analysis, focusing on the theory of ecologically unequal exchange. Then we develop our central arguments: amphibian extinction risks and extinctions in Sri Lanka are largely a byproduct of the development of capitalism as a global system, specifically the particular social relations and economic aims that were installed during the British colonial period. We conclude by exploring how a social-structural perspective might inform amphibian conservation and by recommending areas for future research.

Amphibian Extinction Risks and Extinctions in Sri Lanka

This section summarizes Sri Lankan amphibian extinctions and extinction risks, primarily driven by habitat loss, to provide an ecological context to our social-structural analysis. Later, we explain how the habitats most negatively impacted by colonial and neocolonial relations are those with the highest number of endangered and endemic amphibian species. These ecological details are not

merely background information but are essential to the political-economic argument. They demonstrate how specific habitats and species distributions intersect with patterns of land use imposed by colonial and neocolonial development. Understanding which areas and species are most affected helps illustrate how global economic processes produce uneven ecological consequences.

Due to incredibly high amphibian diversity on the island, especially given its relatively small size (Surasinghe 2009), Sri Lanka has been labeled an amphibian hotspot (Meegaskumbura, et al. 2002). Of the 37 recorded amphibian extinctions globally, nearly half (18) occurred in Sri Lanka, and 76 percent of Sri Lanka's remaining 93 amphibian species are threatened with extinction: 16 are listed as Vulnerable, 38 as Endangered, and 17 as Critically Endangered (Re:wild, et al. 2023).[1] The majority of threatened and extinct frogs in Sri Lanka belong to the genus *Pseudophilautus*—commonly called "shrub frogs," the ninth most threatened frog genera, largely due to their high diversity and threatened status in Sri Lanka (Re:wild, et al. 2023).

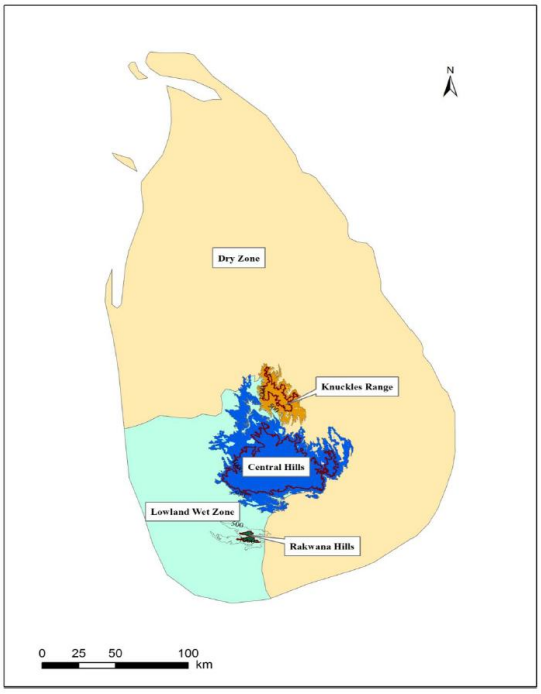
Sri Lanka's wet zone, along with part of the surrounding intermediate and dry zones, collectively called "the Southern Highlands," was designated as one of the 50 Threatened Amphibian Landscapes, which, together, contain more than 70 percent of threatened amphibians despite making up a relatively small area of Earth (Re:wild, et al. 2023). Within this landscape, the Central Hills (see Figure 1) contains the highest number of endemic and threatened species, despite being the site of various forest sanctuaries (e.g., Peak Wilderness Sanctuary), reserves (e.g., Hakgala, Amagamuwa), and National Parks (e.g., Horton Plains) (Batuwita, et al. 2019). The Peak Wilderness Sanctuary of the Central Hills, the Knuckles Forest Reserve of the Knuckles Range, and the Sinharaja Forest Reserve of the Lowland Wet Zone and neighboring the Rakwana Hills (see Figure 1), are considered three "key amphibian conservation priority areas" by International Union for Conservation of Nature (IUCN)-affiliated scientists (Rodrigo 2020).

According to the IUCN, *all* threatened amphibian species are impacted by habitat loss in the Southern Highlands (Re:wild, 2023). Mass deforestation has dramatically reduced forest cover on the island by about 70 percent (de Silva, Ukuwela, and Chathuranga 2021). Especially concerning from a conservation perspective is that the southwestern region, where amphibian fauna diversity is greatest, has lost over 95 percent of forest cover and the remaining forests are fragmented

[1] The number of extinctions and species threatened with extinction cited here are based on the latest assessments of the International Union for Conservation of Nature (IUCN). We would like to thank Kelsey Neam, the Species Priorities and Metrics Coordinator at Re:wild, for more information about these figures (personal communication). Re:wild, Synchronicity Earth, and IUCN SSC Amphibian Specialist Group's (2023) summary of the IUCN's current data concerning amphibian declines follows Amphibian Species of the World (Frost 2023) as a taxonomic source, which identifies 111 species in Sri Lanka. Some sources recognize up to 120 amphibian species in Sri Lanka (Batuwita, et al. 2019; de Silva, et al. 2021). Along with a few caecilian species, the rest are frog species. Note that taxonomies and estimates of imperiled and extinct Sri Lankan amphibian species are evolving (e.g., Mendis Wickramasinghe, Vidanapathirana, and Wickramasinghe 2012; Batuwita, et al. 2019; Ellepola, et al. 2021; Wijayathilaka, et al. 2023; for history of herpetology in Sri Lanka, see de Silva 2001). A final important qualifier: the percentage of amphibian extinctions occurring in Sri Lanka may be far less than half, seeing as there may have been far more than 37 amphibian extinctions in the previous 150 years, the number currently recognized by the IUCN. The actual number of amphibian extinctions could be as high as 222 (Luedtke, et al. 2023).

(Pethiyagoda, et al. 2006; Erdelen 2012). Deforestation in Sri Lanka not only destroys the unique habitats needed for the survival of habitat specialists, it also reduces stream flow, which reduces distribution and reproduction opportunities. This increases the prevalence of invasive species and fragments habitats, thereby reducing geographic and genetic dispersal (Batuwita, et al. 2019). Although this paper focuses on habitat loss, the leading driver of amphibian declines and extinction threats in Sri Lanka, it is important to note that other threats to Sri Lankan amphibians include climate change, increased frequency and intensity of fires, invasive species, and, likely, pollution, especially agricultural chemicals (de Silva 2011; Pratihar, et al. 2014; Batuwita, et al. 2019; Re:wild, et al. 2023).

Figure 1: Five Zoogeographic Zones for Sri Lankan Amphibian Species (Batuwita, et al. 2019).



The Southern Highlands, a Threatened Amphibian Landscape (Re:wild, et al. 2023), include the Central Hills (dark blue), Knuckles Range (orange), Rakwana Hills (dark green), most of the Lowland Wet Zone (light blue), as well as parts of the Dry Zone (yellow) surrounding these areas.

Part of the story of amphibian extinction risks and extinctions in Sri Lanka is geographical and ecological, namely that there is a large percentage of endemic species—around 90 percent (Erdelen 2012; Batuwita, et al. 2019; de Silva, et al. 2021)—on the island. The only other countries with higher percentages of threatened amphibian species—Jamaica (95 percent), Haiti (87 percent), and the Dominican Republic (78 percent)—are also islands with many endemic species (Re:wild, et al. 2023). The wide variety of ecosystems in Sri Lanka, including tropical rainforests, wetlands, and savannahs, and the ecological barriers between regions, creates many distinct bioregions which contributes to a high degree of endemism and biodiversity, especially in the

southwestern rainforests (Surasinghe 2009). Relatedly, many of these species are dependent on tropical rainforest ecosystems, and rainforest amphibians tend to be habitat specialists, less able to adapt to new habitats (Surasinghe 2009).

While part of the story's setting is biophysical, the plot is social. It is social in part because the reason scientists know about the frog extinctions in Sri Lanka is due to specimens taken during the British colonial period and preserved as holotypes in natural history museums, "ghost" species (Collins and Crump 2009: 7) that were not located during later extensive surveys of the island (Meegaskumbura, et al. 2002; Meegaskumbura, et al. 2007). As stressed below, the story is also social because the drivers of amphibian declines do not occur in a social vacuum. Indeed, the holotype specimens were primarily collected "between 1850 and 1940, a period during which rainforests on the island's central mountains and south-western 'wet zone' were being cleared to make way for cinchona and coffee plantations, since replaced by tea and rubber" (Meegaskumbura, et al. 2007: 2). Some analyses of Sri Lankan amphibian declines cite or briefly discuss the historical impact that colonization had on deforestation (e.g., Meegaskumbura, et al. 2002; Meegaskumbura, et al. 2007; Erdelen 2012; Batuwita, et al. 2019). However, within herpetological and conservation literature, we could not locate a study on Sri Lankan amphibian declines that provides an in-depth study of colonization's historical impact and, through its legacy, globalized capitalism's current impact on amphibian habitat destruction.

We take a historical perspective for two reasons. First, mass deforestation, the central driver of the habitat loss and fragmentation that harms amphibian species, began during the colonial period so beginning the analysis after the colonial period would be arbitrary and misleading. Second, and essential to our guiding argument, amphibian extinctions and extinction risks should not be understood as a localized event on the island, but instead, in relation to global networks that emerged from the international development of capitalism. After summarizing the theoretical traditions that inform our historical analysis, we argue that the history of amphibian extinction risks and extinctions in Sri Lanka is incomprehensible without examining British colonization and its capitalist legacy.

Colonialism and Ecologically Unequal Exchange in the Capitalist World-System

The argument that Sri Lankan amphibian extinction risks and extinctions are the byproduct of a capitalist global order is informed by critical theories of development, especially dependency theory and world-systems theory. Rooted in an analysis of Latin America, dependency theory proposed that "underdevelopment in Latin America is the result of the development of capitalism at the world level, which shaped the New World first through mercantile relations and later through direct capital investment" (Dietz 1980: 751). This argument flew in the face of the common Western model of development, embodied by modernization theory, as well as orthodox communist views that underdevelopment in poor countries first required more capitalist development before socialism could take hold. In contrast to both views, dependency theorists argued that the underdevelopment of poor countries was not caused by a lack of capitalist

development, but, instead, was *due to* capitalist development, specifically the integration of "developing" countries into a global capitalist economy as a resource stock for the interests of powerful capitalist states (e.g., Frank 1979; for ecological application, see Shandra, Shircliff, and London 2011).

Dependency theory's argument that "it is not internal characteristics of particular countries so much as the structure of the international system…that is the key variable to be studied in order to understand the form that development" (Smith 1979: 248) takes was influential in the thinking of world-systems theory (Chirot and Hall 1982). World-systems theory posits that a new form of "world-economy" emerged around the long sixteenth century, where "political energy is used to secure monopoly rights" and the "state becomes less the central economic enterprise than the means of assuring certain terms of trade in other economic transactions" (Wallerstein 2011: 16). The capitalist world system is characterized by structural relations between core, semi-peripheral, and peripheral countries (Wallerstein 2004). The developed core is marked by high levels of investment, increasing urbanization to relatively well-developed cities and towns, higher wages, higher specialization, and, eventually, the industrialization of manufacturing. This core

> needed peripheries from which to extract the surplus that fueled expansion. Peripheries produced certain key primary goods while their towns withered, labor became coerced in order to keep down the costs of production, technology stagnated, labor remained unskilled or even became less skilled, and capital, rather than accumulating, was withdrawn toward the core. (Chirot and Hall 1982: 85)

The semiperiphery stands in between the core and periphery in terms of economic and political power. In short, for world-systems theory, *the world order* is the proper unit of analysis (Palat 2014).

There are two central insights from the critical political-economic tradition that inform our argument: first, social-ecological changes and impacts in the periphery should be understood in relation to the world system and second, colonization was a strategy of capital expansion and the core-periphery relations established during colonialism often still structure core-periphery relations today.

World-systems theory has informed a variety of fruitful perspectives in the environmental social sciences and social-ecological studies of development (e.g., Goldfrank, Goodman, and Szasz 1999; Gellert 2010; Moore 2011). Scholars examining the ecological impacts of relations between the core and periphery from a global political-economic perspective argue that core countries "transfer" or "externalize" environmental harms on peripheral countries, or, that "Global South nations are structurally positioned as both a tap for resources and a sink for waste within the world-economic system of extraction, production, and consumption" (Givens, et al. 2019: 2), an argument captured by the theory of "ecologically unequal exchange" (Hornborg 1998; Shandra, et al. 2009a, 2009b; Jorgenson and Clark 2009; Austin. 2010; Jorgenson 2010, 2016; Jorgenson, Dick, and Austin 2010; Bonds and Downey 2012; Foster and Holleman 2014; Gellert, Frey, and Dahms 2017; Bai and Givens 2021; Dorninger, et al. 2021; Ricci 2023; Althouse, et al. 2023; Corsi, et al. 2024; Rammelt and Ylla-Català 2025). Emerging out of a conversation with

dependency theory, world-systems theory, and related traditions from an ecological perspective (e.g., Bunker 1984, 1985; Hornborg 1998; Foster and Holleman 2014; Givens, et al. 2019 Corsi, et al. 2024), ecologically unequal exchange refers to "environmentally damaging withdrawal of energy and other natural resource assets from and the externalization of environmentally damaging production and disposal activities within less-developed countries" (Jorgeson 2016: 6). The theory emphasizes how unequal international trade relations result in net transfers of material flows (typically, natural resources) from lower-income countries to higher-income countries (Ricci 2023). According to the theory of ecologically unequal exchange, not only is the periphery's environment degraded due to economic relations with the core, but, further, the poor and working class in the periphery rarely benefit from these relations due to "the suppression of resource consumption for domestic populations…, often well below globally sustainable limits" (Jorgenson 2016: 9). In short, ecologically unequal exchange points to unequal drains in "metabolic flows of resources through trade" that "have the consequence of depriving the global South countries of vital resources and damaging their local ecosystems, while wealth continues to accumulate for a small minority" (Rammelt and Ylla-Català 2025: 342).

The theory of ecologically unequal exchange has found empirical support for explaining environmental degradation in the periphery in many contexts (for review, see Jorgenson 2016). Relevant here, previous applications of ecologically unequal exchange have shown an association between a higher proportion of exports, especially of primary goods, going to higher-income countries from lower-income countries and higher levels of deforestation/forest degradation in the latter (Shandra, et al. 2009a; Austin 2010; Jorgenson 2010; Jorgenson, et al. 2010). Also pertinent to this project is Shandra and colleagues' (2009b) finding that the number of mammals threatened with extinction in poor countries is positively associated with flows of primary sector exports from poor countries to rich countries. We deepen both lines of research below through a qualitative case study.

We also draw from world-systems theory's arguments that colonization, as one form of imperialism (Etherington 2014), was primarily driven by the expansion of capital markets. For world-systems theory, colonialism is an outcome of capitalism: "European imperialists expanded into external areas of the world in order to open commodity and investment markets, control labor, monopolize resources and trade, and protect those investments from competing core states" (Boswell 1989: 180). Moreover, the establishment of core-periphery relations during colonialism still influences the capitalist world system. Dependency theory and world-systems theory argue that, despite formal decolonialization, the political and economic imbalances between core and peripheral states remain in many cases. This condition is sometimes referred to as "neocolonialism," or the "continued economic and financial control of former colonies by imperialist powers (governments, corporations and multilateral institutions) without direct political control" (Bandarage 2023: 10; though this phrase predates both dependency theory and world-systems theory: see Nkrumah 1965; Smith 1979).

Dependency theory, world-systems theory, and related approaches have been criticized for examining core-periphery relations in terms of market relations rather than in terms of production

relations (e.g., Brenner 1982). This kind of critique can be found in de Silva's (1982) exhaustive study of the colonialization of Sri Lanka, where the "underdevelopment" of the Sri Lankan plantation economy and other non-settler colonies was argued to be largely a result of high degrees of absentee ownership, or "the extra-territoriality of investors" and the dominance of merchant capital. Colonial investors in Sri Lanka had a vested interest in trade and export-oriented production, not in reinvesting surplus in developing industry on the island. For de Silva, the simple division of labor on plantations and lack of investments in specialized machinery that increase the productivity of labor means that the plantation system cannot be accurately termed "capitalist," in the sense of "industrial-capitalist," though they do use the term *merchant capitalism* to describe the power of merchant capital over productive capital in plantation economies.[2]

We agree with Banaji (2022), following Braudel (1992) and others, that it makes sense to speak of *commercial* or, more broadly, *merchant capitalism* in the case of colonial plantations and similar structures where commercial capital "dominates production directly" (Marx 1981: 446). This is the case in

> the colonial export economies [where] the dominant groups were the mercantile interests, for whom production served merely as an accessory rather than an independent objective. … Merchant capital, as the agency which mediated on behalf of production capital in the metropolis, shaped the economic structures of the periphery. (de Silva 1982: 86)

Semantics aside—whether plantations represent a "colonial mode of production," "agrarian capitalism," "dependent capitalism," "plantation capitalism," and so on—we are concerned with the function and embeddedness of Sri Lankan plantations, both colonial and neocolonial, in a capitalist world-system, a global system that, in a quest for profits, installed, and continues to reproduce, export-oriented social-economic systems abroad that primarily benefit capitalists and core countries.

Bolstered by the theory of ecologically unequal exchange, we show that Lenka and Pattanaik's (1979: 50) argument that "Sri Lanka was an appendage of British imperialism providing a classic example of [the] core-periphery model" (cf. Perera 2016) established structural power relations that still influence Sri Lanka's environment and wildlife in the neocolonial period. We focus on the underlying driver of deforestation because habitat loss is the primary driver of amphibian extinction risks and extinctions on the island.

Deforestation and Ecologically Unequal Exchange in the Colonial Period

Although areas of Sri Lanka were colonized by the Portuguese (1597–1658) and the Dutch (1658–1796) before the British (1796–1948), we focus on the latter period, especially colonization from

[2] Merchant capital dominated production capital in colonial plantation economies through a number of means, including management charges and high prices for inputs (de Silva 1982). Merchant capital profited from plantations through the many financial opportunities and power gained from "activities connected with the marketing and sale of export produce—transporting, warehousing, shipment and sale of plantation crops" (de Silva 1982: 192).

the 1830s on, because it is during British rule that "massive impacts on the natural forests of southwestern Sri Lanka and the central hills were recorded" (Erdelen 2012: 37) due to the installation of coffee plantations and, later, tea, cinchona, and rubber plantations, as well as infrastructural projects supporting colonial efforts (see Wickramagamage 1998).

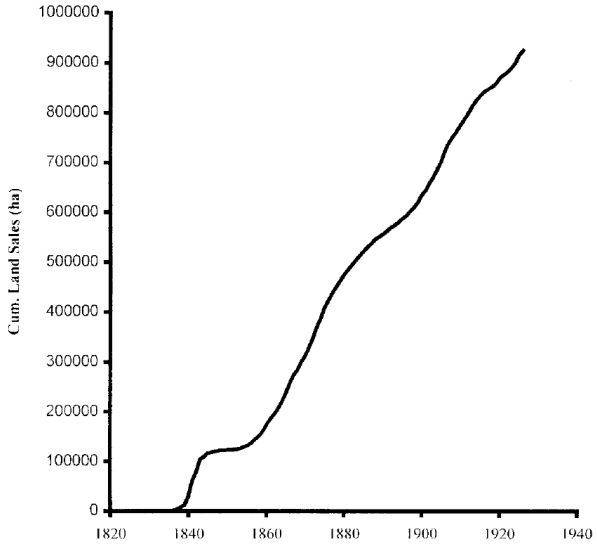
In its feudal period prior to colonization, the Southern Highlands were divided into three categories: (1) the Village Forest, or, the communal lands; (2) the King's High Forest, which consisted of (2a) the Crown Forests, and (2b) the Forbidden Forests; and (3) the forest barrier around the Kandyan Kingdom (Wickramagamage 1998, 2017). The communal lands bordered villages and were "used for shifting cultivation in drier parts of the hill country" (Wickramagamage 1998: 2020). Villagers were allowed to collect firewood, honey, and other goods as well as graze in the Crown Forests, but the Forbidden Forests were restricted to authorized persons (for overview of feudal social relations in Sri Lanka, see Shanmugaratnam 1981). Kandyan Kings valued the forests as a buffer of protection from attacks. There was little deforestation in this period due to a subsistence agriculture-based economy, primarily paddies and home gardens, and low population densities. The communal lands that were cleared for agriculture were left fallow following cultivation until soil could regain nutrients for future growing seasons (Wickramagamage 2017). As Shanmugaratnam (1981: 69) put it, "a system of conservation agriculture had evolved…[which is] characteristic of a society in which use-value dominated exchange value."

During British rule, Sri Lanka underwent profound changes in land ownership, social relations, and ecological landscapes due to the colonists' efforts to transform the island into a plantation-based economy. The pre-colonial agrarian-feudal system, where land use was communal and subsistence-oriented, was replaced by a capitalist model centered on privatization and export. Starting in the 1830s, 15 years after the British annexation of the Kandyan Kingdom, the social relations (Shanmugaratnam 1981; Wickramasinghe and Cameron 2004) and ecological landscape of Sri Lanka transformed in fundamental ways, primarily as a consequence of privatization of forests by the British Colonial Administration for the development of plantations by capitalists (Wickramagamage 1998, 2017; Webb 2002; Bandarage 2023). The colonists appropriated and sold land that lacked formal proof of ownership, which included most of the highlands because, as an agrarian-feudal economy, land was given by kings to villagers based on services provided, not through titled ownership (Wickramagamage 1998). Nearly 13,000 acres of land was literally given away to capital owners between 1823 and 1832 (de Silva 1982). Following the Crown Lands Encroachment Ordinance no. 12 in 1840, which "declared all lands [British] crown lands if people could not prove their ownership" (Department of Land Title Settlement 2024), much of the forest land of the highlands was formally privatized, purchased by capitalists, both European and Sri Lankan, at a low price (de Silva 1982) to establish plantations (see Figure 2), especially in the Kandy and Nuwara Eliya Districts (see Figure 3) (Wickramagamage 2017).

Ordinance no. 12 was followed by more ordinances further solidifying the colonial expropriation and commodification of land (Shanmugaratnam 1981). This new "plantocracy" in Kandyan areas "became all powerful and no one dared interfere in its reserved sphere" (Meyer 1998: 806), established a state and legal infrastructure that benefited monopolistic plantation

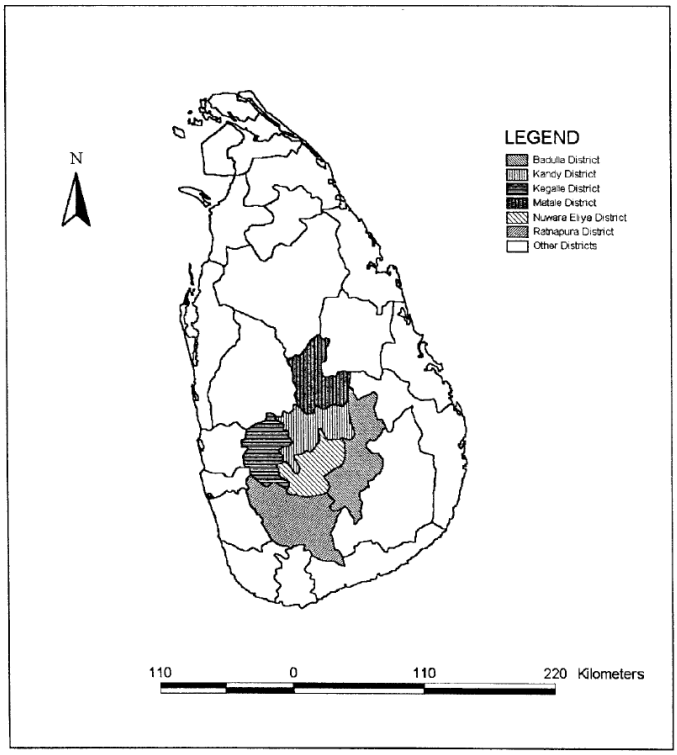
owners, and led to the marginalization of many newly landless peasants as well as the extreme exploitation of poor Tamil migrant laborers brought in from South India to work the plantations (Shanmugaratnam 1981; Wickramasinghe and Cameron 2004).

Figure 2: Land Sales by the British Colonial Administration, 1833–1925



(Source: Wickramagamage 1998).

Figure 3: Sri Lanka's Plantation Districts



(Source: Wickramagamage 1998).

While there were other proximate causes of deforestation, like timber felling and *chena* (slash-and-burn) cultivation, clearing and burning newly privatized forests for coffee plantations and for firewood to cure coffee was responsible for the lion's share of deforestation in the highlands' montane and sub-montane forests from 1830–1880 (Wickramagamage 1998, 2017). In 1880, the colonial Governor, Sir James Longden, noted that deforestation had become so severe that it was pointless to establish a forest administration near the plantations:

> Almost all the forest lands on the slopes and crests of the mountains below 5000 ft., and much above that elevation, have long since been granted or sold by the government to coffee planters.… It may without an exaggeration be said that there are no forests left of such value as to require or justify the creation of an expensive Forest Department. (Quoted in Meyer 1998: 799)

In the late 1860s, a coffee leaf fungus (*Hemileia vastatrix*) began to destroy coffee plants, pushing capitalists to purchase and clear forests at higher elevations, though land sales above 5000 ft (1524 m) were banned in 1875 due to concerns with soil erosion and the siltation of farmlands caused by deforestation (Wickramagamage 2017). Following the spread of *Hemileia vastatrix*, many coffee plantations were converted into tea plantations,

> which were found to be equally profitable. This industry continued to grow until the forest cover in the hill country was reduced to a few isolated patches on hilltops and a few forest reserves situated above the 1524 m elevation. (Wickramagamage 1998: 2022; cf. Webb 2002)

Since 1880, tea and rubber plantations spread rapidly, occupying even more land than coffee cultivation did at its peak. It is notable that the transition to tea impacted labor relations as well. Because tea, unlike coffee, requires year-round cultivation, many of the South Indian Tamil migrant laborers became permanent residents of Sri Lanka (de Silva 1982; Webb 2002).

While immense land use changes primarily began as early as the 1830s due to this privatization of the forests—indeed, by 1880, "highland districts had lost much of their virgin forests to coffee plantations" (Wickramagamage 1998: 2021)—the earliest recorded figures for island-wide deforestation we could locate begin in 1881 (Bandaratillake 2001). Bandaratillake (2001) estimates that closed canopy forest cover plummeted from 84 percent of the island to 44 percent from 1881 to 1956. This is during a period in which Sri Lankan land continued to be commodified into plantations under British rule until 1948 (Bandarage 2023).

There are direct and indirect causes of the mass deforestation driven by the new plantation system installed by the British colonists (Wickramagamage 1998). The direct impact is deforestation to make way for plantations. To reiterate the obvious, these plantations were not established for local food production and consumption, but to grow cash crops for export. The indirect impact relates to the population increase centered around plantation districts. However, the impacts of population growth on the forests should not be overestimated. As Wickramagamage (1998: 2019) explained:

> Plantation agriculture and its associated developments attracted the population to the plantation districts from the low country. This process led to the development of new urban centres and to further expansion of the existing ones.… Population increased in these districts [established during the plantation era] not only as a result of local migration, but also because of the arrival of immigrant labourers from India who came to work in the plantations.… This population contributed little to deforestation, since they lived and worked in the plantations until recently.… In all four districts [Kandy, Matale, Nuwara Eliya, Badulla], the increase in immigrant population is very high.… The present population density in the plantation districts is to a great extent a result of this [colonial period] immigrant population. Thus it can be concluded that population increase was not the major factor in the deforestation in the hill country of Sri Lanka.

In other words, much of the population growth in plantation districts was of immigrants who, because they lived on the plantations, had little impact on forest coverage. Further, even the direct ecological impacts of population increases should be understood in the context of the establishment of plantations.

Although we could not find reports of colonists or British scientists expressing concern about the impacts of deforestation on frog populations, the possibility of the plantation economy causing extinctions was noted in 1843 during the first coffee plantation boom by the Superintendent of the Royal Botanical Gardens, George Gardner:

> Of late large tracts of the country have been cleared of the virgin forests by which they were covered, from the rapid spread of cultivation; and as this is likely to go on to a great extent there can be no doubt that many of those trees which are peculiar to the Island, and local in the range, will long become extinct; and the Botanists of future times will look in vain for many of those species which their predecessors had recorded in the annals of science as natives of the Island. (quoted in Webb 2002: 104)

Deforestation for plantations is especially concerning for amphibian biodiversity because most plantations historically and currently center around the Southern Highlands (Wickramagamage 1998), an area that contains many of Sri Lanka's endemic and threatened species (see Figure 3).

In summary, the British legal and state apparatus facilitated the monopolistic dominance of plantation owners, exacerbating socio-economic inequalities and ecological degradation, as forests were cleared at unprecedented rates. These structural relations and social-ecological outcomes align closely with the framework of ecologically unequal exchange. The plantation economy, built on privatized land and forced or highly exploited labor, funneled profits to British investors while leaving behind deforested landscapes, depleted soils, and impoverished local communities. Tea, coffee, and rubber plantations exported cash crops for Northern consumption, embodying the asymmetrical transfer of ecological goods from South to North without adequate compensation or reinvestment. Capitalists and landlords did not reinvest their wealth into local economies or infrastructure that could have supported sustainable development. Instead, their collaboration with colonial powers entrenched economic dependence and ecological degradation. This perpetuated a cycle in which the profits of ecological exploitation left the country, while the environmental costs—deforestation, soil erosion, and biodiversity loss—remained local. Foreign capital and the

colonial state played the most direct roles in perpetuating ecologically unequal exchange. The British colonial administration not only facilitated the privatization and commodification of land but also built the infrastructure necessary for resource extraction, such as railways and ports. These investments were designed to maximize profits for British investors rather than to benefit local communities. The ecological costs of this development model were immense. By prioritizing cash crop exports, the colonial state accelerated deforestation and soil erosion, leaving Sri Lanka with long-term ecological challenges, including amphibian extinction risks and extinctions.

Deforestation and Ecologically Unequal Exchange in the Neocolonial Period

In addition to providing a compelling explanation for mass deforestation under colonial rule, the integrated framework of ecologically unequal exchange, world-systems theory, and dependency theory also helps shed light on the circumstances surrounding continued threats to amphibian species in post-colonial Sri Lanka. The destruction of habitats that support amphibian diversity cannot be adequately explained in reference to population increases alone[3] and must be understood in the context of protracted neocolonial circumstances in which former colonies like Sri Lanka remain in exploitative and unfair relations with core countries, even after they gained formal independence. The core continues to disproportionately benefit from the periphery via unequal exchange relations, cheap raw materials, debt bondage, cheap labor, and other mechanisms while peripheral states continue to rely on monoculture exports and foreign borrowing to improve their domestic economy at the expense of their natural ecosystems. This has been the case in Sri Lanka, where, since independence, most administrations have, "reproduce[d] the colonial subjectivity and dependency within the world-economy reformulated under the U.S. hegemony" rather than "leading the nation out of dependent economic structures developed under colonialism" (Perera 2016: 33). This section first abridges some of the neocolonial history of Sri Lanka and then

[3] Mainstream explanations for habitat loss often posit that Sri Lanka's deforestation is largely driven by its high population, which jumped from 7.9 million in 1950 to 21.9 million by 2023 (World Population Review 2024; see Ministry of Forestry and Environment 1999; Bandaratillake 2001). However, while the survival demands of a larger population can have negative environmental impacts, an emphasis on population growth as a central, underlying driver of environmental harm ignores the social conditions that shape practices causing environmental harm (for discussion, see Bates 2009). Much of the agricultural expansion causing deforestation in Sri Lanka is for cash crops to be exported, not to feed citizens, so a rising population is a limited explanation. A mere increase in human population cannot explain why Sri Lanka finds itself destroying the habitats of endemic amphibians in order to grow crops for export in the first place. While population has an impact on deforestation, so does income, agricultural GDP, crop production, crop production area, poverty, agricultural land, and other variables (Gamage, et al. 2021). Further, population increases, where populations are concentrated, and their ecological impacts are also only explicable in relation to plantation agriculture (Wickramagamage 1998), and even deforestation driven by peasants and small farmers practicing small-scale food production should be understood in relation to neocolonialism: "Peasants displaced from their traditional lands when they were taken over for export crops, or pasture, or because their fallow periods were shortened, frequently migrate to forest areas in search of improved livelihood prospects" (Barraclough and Ghimire 1995: 14). Indeed, one of the drivers of deforestation in Sri Lanka is "poverty as a consequence of shortage of lands" (Lindström, Mattsson, and Nissanka 2012: 681).

connects these conditions with post-independence drivers of habitat loss, which remains the most significant threat to amphibian species (Re:wild, et al. 2023).

Following independence, Sri Lanka was immediately beholden to financial assistance from the Bretton Woods institutions and adopted a focus on agricultural exports (IBRD 1954). This occurred despite the Sri Lankan state attempting to secure a more interventionist or "state-capitalist" path to development from its independence until the late 1970s (Lenka and Pattanaik 1979). By the middle of the 1970s, Sri Lanka had developed a significant balance of payments problem with its foreign exchanges due to persistent trade deficits. The state required external financial assistance which it only received from the International Monetary Fund (IMF) once its domestic politics had transitioned to the neoliberal, non-interventionist United National Party in 1977 (Chandrasekhar, Ghosh, and Das 2023). With the United National Party's "Open Economy" model becoming the predominant program of development, Sri Lanka pivoted away from the previous attempts to develop a self-sufficient economy and embraced neoliberalism (Bandarage 2023). J. R. Jayewardene's rallying cry "Let the robber barons come in" reflected Sri Lanka's transition to a more authoritarian state with a weaker parliament (to ensure foreign investors that Sri Lanka was a lower-risk investment), more union busting, more financial deregulation, the establishment of Free Trade Zones, and fewer welfare provisions, as well as a deeper dependence on "[f]oreign loans for massive infrastructure projects, the expansion of export production and tourism, an influx of foreign NGOs as well as significant outflow of 'cheap labor' to the Middle East" (Bandarage 2023: 12).

Sri Lanka has been in a state of foreign debt dependency ever since, undergoing 16 different IMF debt restructuring programs over its history (Athukorala 2024). The IMF, and other international financial institutions like the World Bank, have a history of attaching stringent, growth-oriented "best practices" to which states must adhere if they wish to receive assistance (Rittich 2002). These "best practices" range from the market-liberalization policies "dictated" by the IMF in the 1970s to the more current 2023 bailout which has further deepened austerity measures within the country to relieve its foreign debt (Chandrasekhar, et al. 2023; Gunadasa 2024). The conditionalities associated with international debt relief lock countries into dominant economic models from the global North which rely on liberalized, market-oriented strategies that stress the importance of private, corporate-led growth (Peet 2009). In Sri Lanka's case, these policies have consistently focused on expanding the country's export capacity in tea, rubber, coconut and, since the 1980s, garments (Chandrasekhar, et al. 2023: 7).

Sri Lanka's post-independence history must be understood in accordance with its colonial history and "integration with global capitalism" (Chandrasekhar, et al. 2023: 5). Granted, since 1960, Sri Lanka's GDP has increased from $1.41 billion to $84.36 billion and GDP per capita has increased from $144 to $3,828 (World Bank 2023ab). However, Sri Lanka has made a history of trading short-term export profits for short- and long-term ecological and social harm (Vidyaratne 2015). Sri Lanka's colonial past gave way to circumstances of financial dependence and foreign debt which subsequently led to the export-oriented production and foreign investment that still drives the circumstances of ecologically unequal exchange today. For instance, in 2022 the Sri

Lankan central bank devalued its currency by 15 percent in an (ultimately unsuccessful) effort to stave off financial crisis that was caused by its inability to pay off its $4 billion debt (Jayasinghe 2022). Köhler (1998) illustrates how such monetary actions siphon money away from countries like Sri Lanka to high-income countries through foreign exchange. It is the combination of political, productive, monetary, ecological, and trade circumstances that gives rise to the ecologically unequal exchange (Ricci 2019). With a devaluated currency, Sri Lanka's costs of production and labor will most probably decrease, likely incentivizing the expansion of further export production in the country. Despite an increase in GDP since its independence, the levels of income inequality and environmental degradation have only worsened over the period from the 1960s till present (Pata, et al. 2022). Currently, Sri Lanka is in the top five most unequal countries in the Asia-Pacific region for wealth inequality (Gunadasa 2023; UNDP 2024: 19–20). Moreover, the relationship between corporate interests and Sri Lanka's pursuit of growth for the sake of growth underlies a "treadmill of production" that threatens endangered species (Lynch, et al. 2015) and produces ecologically disastrous side effects (Schnaiberg 1980).

The post-independence history of Sri Lanka has been one marked by continued deforestation and increasing commercial land use.[4] There are multiple causes of deforestation in Sri Lanka such as timber production (Sudhakar Reddy, et al. 2017) and the Sri Lankan Civil War (Suthakar and Bui 2008). The two most significant drivers are the expansion of agriculture followed by infrastructure development (Batuwita, et al. 2019). Sudhakar Reddy and their colleagues (2017) estimated that forest cover decreased by 5.5 percent between 1976 and 2014, the primary driver being the expansion of agriculture and plantations. The increase in plantations growing perennial crops like tea is responsible for most deforestation associated with agricultural production (Surasinghe 2009). In fact, in 2014, plantations even occupied a slightly larger area of land (34.2 percent) than forests (33.4 percent) (Sudhakar Reddy, et al. 2017). Tea is the largest agricultural export earner in Sri Lanka (Central Bank of Sri Lanka 2023) and the industry employs around 2 million Sri Lankans (Munasinghe, et al. 2017). Tea plantation growth has been uneven since independence. In part due to the end of a boom in tea cultivation in the 1950s, Humbel (1990) estimates around a 20 percent decrease in former tea land from 1956 until the early 1980s. Subsidies and schemes were developed with the goal of diversifying Sri Lankan agriculture, with some land being converted into coffee, cacao, and other tea plantations, while other plantations were abandoned. Abandoned plantation land typically turns into "rangeland" covered in grasses, scrubs, and ferns can increase soil erosion, river siltation, and landslide risks.

The expansion of tea plantations from 1980 to 2000 is in part a byproduct of further state policies aimed at increasing GDP through an export-oriented economy (Vidyaratne 2015). By establishing the Tea Small Holdings Development Authority (TSHDA), the state provided incentive grants to establish new tea plantations. These grants, which often went to city-dwellers rather than local farmers, drove deforestation for decades because the new plantations often

[4] This is despite the overall rate of deforestation having slowed over time as will be discussed below.

developed along the edges of government rainforests, rather than in the lowlands, leading to further encroachment.

Hand-in-hand with tea plantation expansion, rubber plantation expansion and other forms of agricultural expansion have contributed to further deforestation in Sri Lanka (Mattsson, et al. 2012; Cho, et al. 2022). Rubber products are the third largest export earner in Sri Lanka (Central Bank of Sri Lanka 2023). Although land devoted to rubber plantations peaked in the 1960s, deforestation to expand rubber cultivation continues, especially in the eastern districts, an expansion supported by the Sri Lankan state (Rodrigo, et al. 2009, Cho, et al. 2022). For example, Sri Lanka's growth policies have paved the way for transnational tire and other rubber-based corporations like Firestone and Trelleborg to profit from the country's rubber plantations (Sankalpa, et al. 2003; Cho, et al. 2022).

Continued agricultural expansion negatively impacts amphibian habitats, especially encroachments into the buffer zones of the forest reserves with the highest concentrations of endemic amphibians threatened with extinction (Batuwita, et al. 2019). 90 percent of amphibians reside in regions with agricultural lands (Batuwita, et al. 2019). Concurrent with more forests being converted into plantations, agricultural expansion also included turning floodplains into paddy fields, which harms amphibian habitats (Surasinghe 2009). In fact, Mattsson and their co-researchers (2012) estimated that, between 1992 and 1996, the primary proximate driver of deforestation was for small-scale, rainfed farming, not tea cultivation. Along with negative ecological impacts, it should be noted that even when the percentage of small shareholders increases, this does not mean that the livelihoods of small farmers improve as they must sell their product to factory owners at a cheap price, often lower than the cost of production (Munasinghe, et al. 2017).

Infrastructure development is second to agricultural expansion in driving the destruction of Sri Lankan forests (Batuwita, et al. 2019), especially the many dams created in the 1970s and 1980s (Sudhakar Reddy 2017). With the official aim "to maximize the production of rice and hydropower through the construction of dams across the longest river in Sri Lanka…[and to channel] water to dry areas of the country, producing hydropower along the way" (Perera 2016: 43n), the Mahaweli Development Program (MDP) has been one of the worst dam development projects in terms of deforestation (Sudhakar Reddy 2017). While plans for the MDP began prior to Sri Lanka's neoliberal turn, its development accelerated significantly from the late 1970s on through loans, grants, and investments, especially through the World Bank (Bandarage 2023). Contrary to one of the official aims of the MDP to increase food self-sufficiency, researchers found that "the government was leasing thousands of newly irrigated Mahaweli lands to transnational corporations to cultivate export crops like tobacco using peasants as contract labor" (Bandarage 2023: 98).

Sri Lanka has been criticized for equating development with "infrastructure building and monumentalism," rather than *social* development, a focus that began during the neoliberal turn (Perera 2016). Like the expansion of export-oriented agriculture, much of the infrastructure development in Sri Lanka that harms amphibians and their habitats is closely linked to neocolonial

processes such as indebtedness, land grabs, and exploitation of cheap labor. For example, not only is the MDP responsible for significantly increasing Sri Lanka's indebtedness to external powers, but it has also had numerous negative environmental impacts, including increased agrochemical use and runoff, water quality degradation, soil loss, and, importantly here, deforestation (Tolisano, et al. 1993; Sudhakar Reddy 2017; Bandarage 2023). Along with the forest habitats of Sri Lankan amphibians, the creation of massive dams like the MDP destroys wetlands and related habitats that are ideal for amphibians (Batuwita, et al. 2019). Further, the MDP also engulfed peasant land, which "in turn forced the peasantry to purchase their food, increasing their need for liquidity while simultaneously depriving them of the latter" (Pathirana and Aluthge 2020: 111). Other forms of infrastructure development have also harmed Sri Lankan amphibians, such as increased road construction leading to habitat loss and amphibian roadkill (Suranjan Karunarathna, et al. 2013, 2017).

Taken together, Sri Lanka's continued policies around export-oriented agriculture and debt-based infrastructure projects are intimately connected to the country's more recent history of foreign debt, global economic integration, and economic growth. This is despite recent inroads Sri Lanka has made towards further environmental conservation. Indeed, there is evidence that the rate of deforestation has dropped since 2005, which may reflect the state's abandoning of incentives for tea plantation expansion (Vidyaratne 2015) and indicate that conservation strategies are helping (Sudhakar Reddy, et al. 2017). Moreover, Sri Lanka has a long history of biodiversity conservation (Crusz 1973) and has been relatively proactive in creating hundreds of protected areas and reserves, which cover around 18 percent of the island (Erdelen 2012).[5] However, such developments need to be viewed within the context of Sri Lanka's broader political-economic circumstances.

One of the most troubling recent examples of continuing ecologically unequal exchange, from an amphibian conservation perspective, is further land privatization following a 2019 U.S. Millennium Challenge Corporation Compact, which, for $480 million, opens up more Sri Lankan state-owned lands to privatization, in addition to other changes favored by corporate interests (Bandarage 2023).[6] Forest conservation efforts have suffered from a lack of community involvement and lack of enforcement, and there are difficult tradeoffs between forest protection and the livelihoods of small farmers (Lindström, Mattsson, and Nissanka 2012; Mattsson, et al. 2012), issues that further privatization is likely to only exacerbate. Perhaps more worrying still are the consequences of Sri Lanka's recent economic crisis and the continued influence of

[5] Yet amphibian and reptile conservation has traditionally taken a backseat behind more charismatic mammal and bird species (Erdelen 2012) and there are still forests with high levels of amphibian diversity that remain relatively unprotected (e.g., Janzen and Bopage 2011).

[6] More than 90 percent of forests in Sri Lanka are state-owned, with the Forest Department and Department of Wildlife Conservation responsible for their management and protection (Lindström, et al. 2012). While the state has clearly mismanaged some forestland (see above), state ownership at least allows for large-scale conservation efforts. However, as mentioned in the main text, forest conservation could benefit from strong citizen input and participation to achieve a more "polycentric" form of governance.

international financial institutions. In 2023, Sri Lanka received a $3 billion bailout from the IMF due to its defaulting on its sovereign debt following COVID-19's economic fallout (IMF 2023). This bailout comes with the same kind of strings attached seen throughout the IMF and Sri Lanka's history (see above). The reform program is centered around restructuring the country's debt to make it "sustainable" and better able to promote growth (IMF 2024). An alternative reading of such restructuring is one in which Sri Lanka remains in the thrall of international financial interests and with a circumscribed ability to seek alternatives to its export-centric economy. Rather, these recent events suggest that Sri Lanka will continue to experience ecologically unequal exchange by acting as a producer of cheap resources while its ecosystems continue to bear the brunt of global capitalism's rapacious appetite.

In summary, it is apparent that neocolonial conditions deepening ecologically unequal exchange relations continue in Sri Lanka today. While deforestation during the neocolonial period has not been as extensive as during the colonial period, the legacy of colonialism in the form of commodified land and profit-driven, export-oriented agriculture continues to harm the habitats of amphibians. Further, short-sighted and financially-driven large-scale infrastructure projects not only destroy the homes of amphibians already threatened with extinction, they also intensify Sri Lanka's powerlessness in the hands of foreign, powerful lenders. Importantly, the amphibian-harming practices of the neocolonial age are almost unthinkable without the legacy of British colonialism and its neocolonial legacy. That falling prices in tea can still cause Sri Lanka such extensive economic and social turmoil (Munasinghe, et al. 2017) and its continued debt dependency on international financial institutions and powerful states (Bandarage 2023) both illustrate how Sri Lanka is still "chained" to the world capitalist system for "both financial and technical assistance" (Lenka and Pattanaik 1979: 53). In short, Barraclough and Ghimire's (1995: 13) observation that the "expansion of agro-exports frequently occurs at the expense of the forest" is as true in the neocolonial period as it was in the colonial period.

Conclusion

Sri Lanka has the highest number of recorded amphibian extinctions and most the island's remaining amphibian species are threatened with extinction. From a critical political-economic perspective, we show that amphibian extinctions and extinction risks are a byproduct of the global development of capitalism. Mass deforestation of the Southern Highlands, the region of Sri Lanka with the highest diversity of endemic and endangered amphibians and a Threatened Amphibian Landscape (Re:wild, et al. 2023), began following the commodification of land to establish plantations under British colonial rule. The core-periphery power relations installed during colonization remain in the neocolonial period, continuing to condition the forces driving deforestation to this day. Higher-income countries and multinational corporations have financially benefited from Sri Lanka's "development" at the expense of many Sri Lankans and the island's diverse amphibian populations and their habitats, a relationship consistent with the theory of ecologically unequal exchange. The spread of plantation agriculture also intensified dependency

on imported food and goods, as land previously used for subsistence farming was converted into export-oriented plantations. This dependence on external markets for basic needs undermined food security and made local economies more vulnerable to fluctuations in global commodity prices, deepening ecological and economic instability. Despite Sri Lanka's exporting of cash crops, it nonetheless assumed a trade deficit as the result of its foreign dependence on the necessities of life.

Our central contribution to the literature is to the study of amphibian declines and extinction risks, the most threatened vertebrate class (Luedtke, et al. 2023). As discussed above, literature on amphibian declines and extinction risks tend to emphasize proximate causes (e.g., habitat loss, climate change impacts) rather than the underlying social drivers of these proximate causes. Through a reasonably in-depth case study of the country with the highest number of recorded amphibian extinctions, we contribute to a growing literature on the social-structural drivers of amphibian declines and extinction risks in particular and biodiversity loss in general. Following Shandra and their colleagues (2009b), we think the theory of ecologically unequal exchange is useful for explaining and conceptualizing the social-structural drivers of extinction risks. Further, we advance ecologically unequal exchange, a theory which tends to encourage quantitative research (Theis, Betancourt, and Sikirica 2024), through a novel and qualitative case study application. More generally, we show how a sociological perspective can provide a more comprehensive understanding of the relationship between human societies and animals, a relatively young yet important and growing area of sociological analysis (e.g., Nibert 2003; Kalof 2007; Irvine 2008; York and Longo 2017).

This case study opens several avenues for future research, including: first, exploring more systemic approaches to combat amphibian extinction risks; second, sociological analyses of the underlying drivers of more proximate causes of amphibian declines, extinction risks, and extinctions; and third, a deeper engagement with value theory to integrate ecologically unequal exchange with theories of unequal exchange.

As our goal here was not to develop a technical or programmatic amphibian conservation plan (for example, see Erdelen 2012), the first avenue for future research is practical: How can Sri Lanka and other countries in the global South better protect amphibian fauna and their habitats despite the current global political economy? On the one hand, the Sri Lankan people and government have agency and some level of power (Perera 2016). There have been many resistance movements throughout the colonial and neocolonial period, which continue to this day (Fernando 2023), and a handful of administrations that attempted to defy neocolonialism, especially in the few decades following independence (Bandarage 2023). A possible future for Sri Lanka is one of economic democracy and "bioregionalism," characterized by "local self-sufficiency as well as community control over water, land, and other natural resources, including plant and seed varieties" (Bandarage 2023: 212). The vision of the newly elected president, Anura Kumara Dissanayake, emphasizes rejecting neoliberal economic policies and prioritizing self-reliance through local economic development and equitable resource distribution, aligning with calls for bioregionalism and economic democracy. By advocating for sustainable agricultural practices and

opposing the short-sighted exploitation of natural resources, Dissanayake's platform echoes critics of export-focused policies that undermine biodiversity. His approach will need to address the structural constraints of Sri Lanka's debt dependency and external pressures, which complicate efforts to implement transformative ecological and economic reforms.

On the other hand, Sri Lanka is deeply indebted to the IMF, China, India, and other institutions, banks, and states, and finds itself in a battleground of corporate and foreign state interests, none of which likely have the social and ecological wellbeing of Sri Lanka as their first priority (Bandarage 2023). While much of Sri Lankan history has sought a "dependent capitalist" path to development, even the alternative nationalist attempts to develop "state capitalism" internally failed due to a "[l]ack of capital, increasingly adverse terms of trade with the imperialist bloc and keen competition from other raw materials producing countries" (Lenka and Pattanaik 1979: 53). It is difficult to imagine an alternative social-ecological future for Sri Lanka without debt forgiveness and external financial support, perhaps through ecological reparations. Although we do not know what the future holds for Sri Lankan people, wildlife, and forests, we hope that this case study inspires future research to explore how conservation efforts can avoid some of the negative impacts that the capitalist world system has on biodiversity, both in Sri Lanka and elsewhere.

A second route for future research is sociological explorations of the underlying drivers of other proximate causes of amphibian declines and extinction risks. We focused on the social forces driving habitat loss because it is the primary proximate driver of amphibian extinctions and extinction risks globally, including in Sri Lanka. However, there are other forces harming Sri Lankan amphibian populations, including fires, sometimes set by farmers and ranchers (Surasinghe 2009); invasive species, like introduced freshwater fish feeding on frog eggs (Bambaradeniya 2002); and, most importantly, climate change (Re:wild, et al. 2023). The IUCN estimates that climate change negatively impacts 89 percent of threatened Sri Lankan amphibian species (Re:wild, et al. 2023; see Kottawa-Arachchi and Wijeratne 2017). Climate change can impact amphibians through a number of processes depending on taxon and habitat (Collins 2010; Surasinghe 2009; Nowakowski, et al. 2017). Further, the impacts of climate change, deforestation, and biodiversity loss are interrelated: deforestation is the second leading cause of greenhouse gas emissions and climate change can worsen biodiversity loss (Sudhakar Reddy 2017). The fact that Sri Lanka has done comparatively little to contribute to climate change in terms of carbon emissions per capita, the negative impacts of climate change on the island are a clear case of climate injustice (Bandarage 2023; e.g., Sparenborg 2022) and also consistent with the theory of ecologically unequal exchange, which can be interpreted as a theory of global environmental injustice (Givens, et al. 2019). Future research should examine the underlying drivers of these proximate causes of amphibian declines, extinction risks, and extinctions in Sri Lanka's Southern Highlands and other Threatened Amphibian Landscapes.

A third avenue for future research is more theoretical. Our analysis focused on asymmetrical material flows from lower- to higher-income countries and resulting environmental destruction in the periphery, which meets the defining characteristics of ecologically unequal

exchange. However, this project lacks a deep examination of the unequal exchange of *value* (for review, see Ricci 2019). Emerging from the critical political-economic tradition, this earlier use of the term "unequal exchange," predating and influencing ecologically unequal exchange, is used to describe the lopsided economic benefit of global-capitalist trade relations for the core at the expense of the periphery (Emmanuel 1972; Amin 1974; see Ricci 2019; Rammelt and Ylla-Català 2025). Dependency theory and world-systems theory emphasize how the global economy results in unequal exchange relations between the core and periphery, a thesis that still finds strong empirical support today (e.g., Hickel, et al. 2022). Our analysis is vulnerable to the criticism that it lacks a "a definition of real value distinct from price" and an analysis of "why real non-equivalence takes the opposite form of monetary equivalence" (Ricci 2023: 23). Future research into extinction risks and habitat loss would benefit from a more integrative approach by drawing on innovative conceptual and empirical work that strives to synthesize the theory of ecologically unequal exchange, focusing on asymmetrical material flows, with theories of the unequal exchange of value (Foster and Holleman 2014; Ricci 2023; Rammelt and Ylla-Català 2025).

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Disclosure Statement: Any conflicts of interest are reported in the acknowledgments section of the article's text. Otherwise, authors have indicated that they have no conflict of interests upon submission of the article to the journal.

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