The Schumacher Institute



# Deforestation and the Risk of Collapse: Reframing COVID-19 as a Planetary Boundary Effect

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# About the author

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# Abstract

The COVID-19 pandemic was a symptom of the fundamental structures of industrial civilisation, and it is an early warning signal for how this civilisation is rapidly eroding the very conditions of its own existence.

Over the last decade, environmental scientists have warned that human activities are increasingly at risk of breaching planetary boundaries, which define the environmental limits in which humanity can safely operate. As industrial civilisation increasingly encroaches on natural ecosystems, we are reducing this 'safe operating space' for human survival.

A reframing of the COVID-19 pandemic in the context of wider biophysical processes reveals that it constitutes a biophysical disruption between the Earth system and human systems, representing an intensifying violation of planetary boundaries which has escalated over a period of decades since at latest the 1970s. A signature event in this process was the 2008 financial crash, which was rooted in a fundamental geological transition into a new era of lower net energy, driving a shift to more expensive and

dirtier forms of unconventional energy financed by massive debt-expansion through quantitative easing. This in turn drove continued forms of industrial expansion which only continued to deepen the breach of planetary boundaries. One of the frontlines of this breach of planetary boundaries is the persistent impact of continuing deforestation, which increases the chance of pandemics of zoonotic diseases such as COVID-19. However, the latter appeared to originate from the hunting of bats in China, and was thus a symptom of wildlife exploitation. While the COVID-19 outbreak itself may not have been a direct result of deforestation, deforestation is part of a wider set of human activities which are increasingly encroaching on natural environments, and increasing the chance of exotic diseases jumping from species like bats to humans.

Today, COVID-19 is ushering in, at break-neck speed, the demise of the age of fossil fuels. While on the one hand, this might offer renewed hope to avert the most dangerous climate scenarios, it also poses a serious risk to the fundamental supply-chains that sustain the energy flows, manufacturing and food production activities of all societies.

That requires a dramatic shift to new forms of sustainable production across critical industries encompassing energy, mining, agriculture, transport, manufacturing and finance. This should involve a series of interlinked systemic shifts involving a transition to renewable energy systems; introducing new circular economy principles; radical monetary reform; and an economic paradigm shift away from GDP.

One of the most urgent areas for immediate mitigating action is tackling deforestation through transitioning to new modes of sustainable production. While frequent attention is often focused on palm oil, the commodity requiring the most urgent attention is in fact beef, the largest driver of climate-linked deforestation emissions. An inclusive, cooperative approaches involving standardised local regulation of all relevant commodities is recommended, and considerable progress in tackling deforestation in Malaysia is highlighted as a potential best practice case study. Yet such approaches must come in partnership with transformations in the developed world to tackle the 'endless growth' dynamic of their economies by restructuring core industrial processes through the preceding interlinked systemic shifts.  Overall, the global systemic transformation called for entails a transition to a form of 'ecological civilisation' capable of functioning within planetary boundaries.

**Keywords:** *COVID-19; planetary boundaries; EROI; oil; transition; systemic risk; collapse; deforestation*

# Executive Summary

### Industrialisation and the systemic drivers behind the pandemic

The COVID-19 pandemic took all governments by surprise, but it was ultimately predictable and indeed predicted. Numerous disease experts over the last decades have warned repeatedly not merely of the growing risk of a global pandemic, but went so far as to conclude that a single pandemic would be inevitable this century, and that several pandemics would be likely.

The basis of these predictions is invariably rooted in a single broad diagnosis concerning the nature of global industrial expansion. Due to the increased contact between human settlements and wildlife in previously untouched natural ecosystems as a result of global industrial expansion, as well as the increased complex interdependence of countries, the risk of a global pandemic was considered a question of 'when' rather than 'if'.

Deforestation, of course, appears as one of the major specific crises which is a consequence of industrial expansion, and directly exacerbates the risk of exotic disease transmission due to increasing encroachment of human activities into natural ecosystems.

However, while there have been a number of recent major studies warning of the future risks that deforestation might pose in terms of the next pandemic, it is important to recall that the specific trigger of the COVID-19 pandemic was not deforestation in itself, but rather a set of intrusive human activities in China involving the hunting and consumption of wild animals for human consumption. These activities can clearly be linked to China's structure as an expanding industrial society, less so directly to deforestation.

### The pandemic as a planetary boundary effect

While deforestation is undoubtedly increasing the likelihood of zoonotic diseases jumping to humans according to numerous studies, it remains one factor relating to a total of nine 'planetary boundaries' which we are in danger of breaching. Within these boundaries, subsists the 'safe operating space' for human civilisation. Beyond these

boundaries, that 'safe operating space' begins to erode. The scientific data demonstrates that we have crossed four of these planetary boundaries around five years ago, one of which concerned land-use change – a category that includes trends such as deforestation. This means that addressing the full scope of causes behind the risks of the pandemic, and future pandemics, requires full attention not solely to the singular issue of deforestation, but to understand this issue in the wider context of its interconnections with several other crises linked to industrial civilisation.

Doing so allows us to reframe the COVID-19 pandemic as a symptom of the continued 'overshoot' of planetary boundaries, and thus a direct manifestation of the shrinking of the 'safe operating space' for human civilisation. One of the clearest signals of this shrinking is the structural crisis the pandemic has generated in relation to the normal functioning of the global economy, which has been forced into a state of contraction no matter which strategy of response is undertaken (e.g. mitigation, suppression, herd immunity). The pandemic, thus, should be understood not as a single crisis, but as a convergence point occurring in the context of a continuum of crises over the last few decades associated with industrial civilisation's overshoot of planetary boundaries.

## Deforestation and the risk of collapse

While deforestation was therefore not a direct trigger of the COVID-19 crisis, it remains a major risk-enhancer for future pandemics. Since the COVID-19 pandemic, a range of scientific studies have demonstrated the nature of this risk, underscoring the urgency of tackling deforestation as a principal mechanism to reduce the danger of another pandemic.

Deforestation is now widely recognised in the scientific literature as a symptom of planetary overshoot. This includes a direct role in driving up rates of carbon emissions contributing to global climate change (accounting for 15 percent of emissions), exacerbating local and regional climate volatility, and even more seriously, contributing to the near-term destabilisation of the stable resource relationships by which human societies are able to function. One recent study in particular warns of a 90 percent probability of industrial civilisation experiencing a collapse as a result of current rates of deforestation. Coupled with its role in heightening the risk of future pandemics, this data underscores the civilisational significance of developing a global strategy to defeat deforestation.

## Culpability for deforestation: which commodity?

Yet this analysis demonstrates that the conventional Western approach to tackling deforestation, particularly adopted within the European Union, is deeply flawed. First and foremost, there is the question of culpability. A common narrative among Western environment movements tends to situate deforestation as the consequence principally of activities by developing nations in the Global South. But this simplistic narrative can serve to displace the assignment of responsibility onto developing nations without sufficiently acknowledging the central, driving role of Western and European nations.

It is important to note, then, that despite the EU's ostensible concern to tackle deforestation as expressed in recent legislation targeting palm oil, as well as ongoing discussions and draft proposals by policymakers in Brussels, Europe is itself a major driver of deforestation, both directly due to its own forest and agricultural practices, and indirectly due to its consumption of commodities linked to deforestation abroad.

Secondly, this analysis notes that the EU's singling out of palm oil as the locus-point of its anti-deforestation strategy is deeply questionable from a number of environmental, scientific, strategic and policy perspectives.

The number one biggest driver of deforestation in the world is beef production, which accounts for some 34 percent of carbon emissions linked to deforestation, produced largely in South America. In contrast, palm oil produced in the Asia-Pacific accounts for some 14 percent, less than half of this quantity. Yet about a third of the EU's beef imports come from illegally-deforested zones in South America. European Commission data also showed that between 1990 and 2008, soybean products imported from South America accounted for roughly 82 percent of deforestation attributed to the import of oil crops into the EU, compared to palm oil imports accounting for 17 percent of deforestation associated with EU oil crops. In this context, the focal-point of the EU's anti-deforestation policies on palm oil as opposed to commodities including beef and soy is fundamentally flawed.

The EU's specific policy prescription on palm oil has also been discredited by numerous scientific studies attempting to assess the efficacy of boycott approaches to single commodities. These have examined the potential and probable consequences of the policy option of banning palm oil, finding that the approach is liable to generate even

more devastating environmental consequences by driving greater rates of deforestation, largely by forcing consumer demand to switch to oilseed alternatives to palm oil which, however, use multiple times more land, water, fertiliser and energy. This would drive far greater rates of deforestation than palm oil. Therefore, the EU's entire policy prescription is ecologically dangerous. A different approach is required. Yet the nature of such a new potential framework to tackle deforestation can only be developed in the context of a wider analysis of systemic causes of the current crisis.

**Industrial expansion and limits to growth**

Focusing solely on deforestation as the key to addressing pandemic risks is a mistake given that deforestation appears simply as one frontline symptom among many others rooted in a range of processes of industrial expansion. Recognising that deforestation is fundamentally a symptom of deeper industrial processes rather than a primary driver in itself, and only one symptom among several others, underscores the need to widen the scope of our analysis toward examining the relationship between deforestation and the structures of industrial civilisation.

While the planetary boundaries framework offers a sound scientific basis to conceptualise industrial civilisation's increasingly deleterious relationship with its own planetary support systems in the natural environment, it contains an important lacuna with respect to energy systems.

The new scientific discourse on planetary boundaries of which deforestation can be understood as a key factor deforestation builds on a number of sophisticated mathematical models designed to examine industrial civilisation's relationship with the natural environment, which originated in the 'limits to growth' work originally conducted in the 1970s at MIT. Numerous studies following this work have corroborated and extended the findings of the MIT model, which identified a likely business-as-usual scenario consisting of the potential collapse of global civilisation from around the period 2030-2050 onwards.

## The need for biophysical economics

A key component of this modelling work was industrial civilisation's resource requirements, including energy and mineral resources. Not only are the model's findings consistent with the current scenario of escalating pandemics occurring as a symptom of planetary overshoot (the breaching of 'limits to growth'), but more recent modelling work confirms that one of the core locus-points of this overshoot occurs in relationship to hydrocarbon energy consumption and its relationship to a potential energy transition. This highlights a key gap in the planetary boundaries discourse, which tends to ignore the fundamental role of energy inputs in enabling the economic growth that underpins industrial societal functions.

The emerging discipline of biophysical economics helps us to fill this gap by drawing attention to the critical scientific measure of Energy Return On Investment (EROI), which compares the quantity of energy inputs to energy outputs for any resource. Studies tracking the EROI dynamics of fossil fuel resources demonstrate a consistent decline in their efficiency, with increasing quantities of energy required to extract an ever-decreasing amount of energy usable for societal functions. As this process has intensified due to the transition from conventional to unconventional fossil fuels since 2005, it has increased the energetic cost burden to our economies.

This dynamic is a pre-eminent driver of accelerating processes of industrial expansion. It compounds the endless growth imperative associated with unregulated forms of neoliberal capitalist social property relations, and led to a vicious cycle of accelerating fossil fuel consumption and production to attempt to sustain economic growth. While being a direct driver of carbon emissions responsible for a civilisational trajectory toward a dangerous climate, this fossil fuel-centred global economy is also integral to the dynamics of expanding industrial consumption and production that, in turn, driver the breaching of key planetary boundaries, including land-use change issues associated with deforestation.

Simultaneously, as the extraction and production costs of fossil fuel industries (especially the US shale sector which accounts for some 90 percent of production growth), have far outweighed profitability due to lower market price dynamics, the industry has been forced to borrow excessively. Massive quantitative easing (QE) programs have on the one hand helped to keep the market price of oil down, while also shoring up the increasingly

uneconomical activities of the oil industry. Yet the very same programs have in this way created the conditions for the internal crisis in the economic fundamentals of the industry. Even before the onset of the pandemic, the most robust forecasts warned that this predicament is ultimately unsustainable and bound to lead to both the implosion of the oil industry as well as to an economic crisis due to the industry's unrepayable debt, one that would undermine the integrity of the global economy. In other words, continued global dependence on fossil fuels, oil in particular, plays a central causal role in the breaching of planetary boundaries that began in the 1970s.

## Biophysical roots of global oil sector crisis

The global oil crisis triggered by the COVID-19 pandemic, in the form of the unprecedented collapse in demand (as reflected in plummeting oil prices), was therefore part of a wider process, symptomatic of a sequence of escalating crises related to industrial civilisation's intensifying breach of planetary boundaries.

Understanding the crisis in this way provides new insights into immediate risks and longer term societal consequences. The shut-down of significant sections of the global oil industry due to the pandemic-triggered collapse in demand threatens to permanently decimate some shut-in oil reserves by up to 10 percent, implying that global oil production reached a peak in 2019 to which it is unlikely to be able to return even if demand returns. If this analysis is correct, then this reinforces the necessity for a holistic-systemic framework to understand the interconnected nature of what appear to us as separate crises. In other words, not only must the breaching of planetary boundaries, deforestation, climate change, the pandemic, and the global oil sector crisis be understood as manifestations of a single crisis, this wider ecological and biophysically-informed approach allows us to recognise how a crisis in each of these sectors will likely feedback across all of them – as identified by Thomas Homer-Dixon's 'synchronous failure' framework.

## The mechanisms of collapse

As Dixon showed, it is precisely the synchronisation of these systemic failures which can overwhelm the overall system's capacity to mobilise an effective response, potentially resulting in a systemic collapse. There is a serious danger that this process can lead to a self-reinforcing amplifying feedback loop, in which episodes of Earth System disruptions

(ESD) trigger the destabilisation of human systems (HSD). As that destabilisation process intensified, the capacity of human systems to address deeper causes of ESD or to respond effectively to ESD is reduced. This increases the vulnerability of the human system to another episode of ESD. The sequence of events human civilisation has experienced over the last decades including three global financial crises, two global energy crises, major bouts of international civil unrest from Occupy to the Arab Spring to Black Lives Matter, along with the global pandemic and the continued escalation of climate change, all illustrate that civilisation is currently experiencing a self-reinforcing ESD-HSD cycle of global intersystemic crisis and breakdown.

However, while the ESD-HSD framework identifies global systemic vulnerabilities, it also highlights the scope for human agency in transforming human systems in order to minimize scope for Earth system disruption. The focal-point of action needs to be on strengthening human systems in order to mitigate and avoid Earth system disruption.

**From mitigation to transformation: Key policy recommendations**

**1** A holistic whole-systems approach is necessary to address the drivers of pandemic risk, including deforestation, by recognising their systemic interconnections.

This analysis demonstrates that several key sectors face immediate risks from the unfolding of the pandemic and its myriad intersystemic consequences, particularly, the global industrial food system, which is fundamentally dependent on oil inputs at every point; including the manufacturing of plastics, on which many industries are fundamentally dependent; transport networks which are of course currently heavily dependent on liquid fuels derived from hydrocarbon sources, principally oil. To mitigate and avoid these risks requires a sequence of deep-seated interlinked structural transformations. This must take the form of an intersystemic transition encompassing simultaneous transformation of the underlying energy system, the associated socio-economic system, and the twin paradigms of industrial extractivism and market consumerism with which the latter is indelibly linked.

**2** Economic policy must shift away from market supremacism to the recognition of a need for intelligent management of markets by political stakeholders: a 'life-boat economy'

The pandemic has changed the world permanently, and is a signal that the human system has entered into a period of synchronous failure symptomatic of a wider decadal process of breaching planetary boundaries. Traditional laissez faire market-based supply-demand dynamics and price mechanisms have proven incapable of preparing for and responding to these complex intersystemic economic consequences which often arise out of these very dynamics and mechanisms. They tend to decrease resilience, because they fail to recognise the shared global public goods that involve the most severe planetary boundary breaches, such as climate change, biodiversity loss and nutrient pollution.

This necessitates an end to the neoliberal model of economics theoretically requiring a minimisation of state-involvement in the economy, and vindicates the need for state actors and public authorities to play a coordinating role in markets. This does not mean the elimination of markets, but their recalibration to operate beyond traditional narrow concerns for shareholder profits, and instead focus on the protection and delivery of public goods.

We suggest that this be understood as a 'life boat economy', in which key actors in the system play the role of organising economic activities so that they are geared toward the wider benefit of society, through the production public goods and services rather than purely for the benefit of a few.

**3** Unprecedented investments in the establishing of a new global renewable energy system are necessary to develop a new sustainable underpinning for global economic activity, but this will not be commensurate with sustaining the old model of 'endless growth'.

To avoid an escalation of the very causes behind the current crisis doubling-down on visions of a sustainable transition away from fossil fuels toward new, renewable energy systems. Such a transition needs to be integrated with emergency economic responses to the pandemic. The longer that the transition to a new sustainable industrial infrastructure is delayed, the bigger the impact of the global oil crisis on critical supply-chains across energy, food and manufacturing.

The integrated nature of the energy-economic transition is also critical. The shift away from fossil fuels entails a fundamental movement away from the traditional energetic source of industrial civilization's capacity for continuous economic growth over decades and centuries. Several studies demonstrate that while the transition to a renewable energy system is essential due to the internal decline dynamics within the fossil fuel system, doing so does not free industrial civilization from biophysical constraints. Renewable energy has its own limitations, and cannot sustain an 'endless growth' economic paradigm due to a ceiling on EROI values which is far lower than what was achievable during the early twentieth century heyday of fossil fuel production.

This therefore requires confronting the possibility that continued GDP growth may no longer be possible in a post-pandemic context. Emerging biophysical evidence indicates that due to ESD-HSD dynamics, the global economy will inevitably experience a form of contraction. This underscores to a greater need for revised notions of prosperity beyond GDP that uphold 'well-being economies' within planetary boundaries, along with a much greater concern for the true costs of natural resource exploitation.

Stimulus packages will need to not just attempt to kickstart economic activity, but to facilitate longer-term re-designs of our economies from the ground up to enable rapid transitions to sustainable and resilient economic foundations. Such clean fiscal recovery packages can create greater resilience to looming threats like climate change, while also having the most potential in driving strong economic performance within planetary boundaries and biophysical constraints.

**4** The only viable way to tackle deforestation is by transforming production practices across all relevant commodities, rather than singling out any one in particular.

The shift to a new economy requires a fundamental transformation in production and consumption habits to rollback patterns of activity that are bound up with processes of industrial expansion which can be traced directly to complicity in the biophysical processes driving the heightened risk of disease outbreaks.

Among the most urgent areas of transformation to reduce the risk of the next pandemic is deforestation. While commodities like palm oil have been rightly criticized for

production techniques causing deforestation, in terms of practical policy, legislation and certification programmes, considerably less attention has been played to much the larger drivers of deforestation in the form of beef and soy. Such inconsistencies need to be urgently addressed and resolved. For instance, the European Union has banned palm oil for biodiesel as part of an effort to tackle deforestation but has done little about its own consumption habits which encourage the unsustainable production of other commodities such as beef, which is implicated more than double the levels of deforestation. The EU's singling out of palm oil while giving a free-pass to other commodities is therefore misguided.

This suggests that the predominant strategy on deforestation favours Europe's domestic biofuels industries and oilseed producers while doing nothing to curtail imports of beef or soy which by far play the largest role in driving rates of tropical deforestation, principally in South America. Yet the EU strategy ignores the fact that a shift to alternative domestic sources of biofuels – such as soy and rapeseed – would still produce carbon emissions at a higher level than that of traditional fossil fuels.

**5** Incentivisation structures, rather than bans, are required to accelerate the most effective forest protection approaches.

This is further complicated by the problem identified across a range of scientific studies that an outright on ban on palm oil in particular – which is the EU's current policy on biofuels – would likely cause more harm to the environment by displacing global biodiversity losses instead of stopping them. Without reducing underlying sources of demand, demand would instead switch to alternative commodities which, however, use far more land end energy than palm oil, therefore potentially driving far greater rates of deforestation.

A boycott-only approach also tends to incentivise producers to find ways to circumvent the boycott, by accessing other markets (such as India and China), where environmental regulations are far less stringent. This once again undermines the entire point, and increases the risk of continued deforestation.

To stop the scourge of deforestation requires a much more joined-up approach focused on transforming production at source, which further requires scaling up successful

policies through appropriate incentivisation structures. To understand what might be working, we must acknowledge the data from the 2020 State of the World's Forests report, which proves that the rate of global deforestation has been declining over the last few decades. From the 1990s to the period between 2010 and 2020, the net loss of forest area decreased from 7.8 million hectares per year to 4.7 million hectares per year.

Part of the reason for this is that a number of tropical developing countries have recently been through a forest transition, a shifting from net deforestation to net reforestation, achieved through new land-use policies. However, in recent years this progress is in danger of coming undone. Data from the Global Forest Watch project shows that primary forest loss was 2.8 percent higher in 2019 than the previous year.

In direct contradiction to the EU's deforestation approach, we find that the country that lost the most primary forest in 2019 was Brazil. And while Brazilian deforestation has accelerated, there has been significant success in reducing the rate of forest loss in Malaysia. According to Global Forest Watch, domestic forest conservation policies and new sustainable cultivation practices for oil palm plantations have caused a decrease in the rate of primary forest loss in Malaysia year-on-year for the last 3-5 years. The absolute scale of deforestation in Malaysia is also far below the level of Indonesia's, which is a larger producer.

**6** Voluntary sustainability programmes are inadequate. Enforceable, mandatory legislation within producer countries is necessary to help criminalise practices that lead to deforestation.

Malaysia's success in slowing the rate of deforestation in recent years builds on a longer-term process. Although its oil palm area continued to expand from 1973 to 2010, studies show that deforestation began to slow down from the mid-1980s, due to economic diversification as well as the potential impact of Malaysia's early pledge to protect the country's forest cover at the 1992 Rio Earth Summit.

However, most of the more recent progress has coincided with the implementation of a new national sustainable certification scheme, Malaysia Sustainable Palm Oil (MSPO) – the world's first government-backed, legally-enforceable sustainable certification programme for palm oil. Under the programme, the government would enforce a

moratorium on palm oil expansion to protect forest cover at 50 percent, accompanied by enforced mandatory sustainability standards aimed at certifying 100 percent of Malaysia's palm oil production.

There is still insufficient scientific data available on MSPO. Despite this, preliminary indications from independent observers suggest that the scheme's "best of category" operations retain impressive sustainability credentials and labour rights policies. The main challenges are ensuring uptake among smallholder farmers; improving some of the technical standards; and ensuring robust local implementation which must be done in coordination across thirteen local states which have considerable autonomy on land-use policies amidst the federal government's commitment to 100 percent sustainability in the palm oil sector. These complex internal dynamics create political challenges in the implementation of federally-mandated sustainability policies.

**7** Inclusive and cooperative partnerships between producer and consumer countries are critical to ensure that successful local approaches are rapidly supported and scaled.

In this context, it can be concluded that the EU approach to palm oil is a serious environmental error which has worked to eclipse and isolate important local efforts like MSPO. Instead of ignoring and alienating countries like Malaysia who have not only made a clear sustainability commitment but are also attempting to execute that commitment (imperfectly or otherwise), a more effective approach is to find ways to scale-up and support the MSPO model. This in turn could establish a framework for cooperative action that can be strengthened within Malaysia and applied to other production processes outside Malaysia in areas at risk of deforestation. The MSPO model could, for instance, provide a powerful test-case for a viable sustainable conservation approach that could be applied not only in other areas of Southeast Asia, but also in South America and elsewhere to address deforestation challenges facing other oilseeds and, of course, the biggest driver of deforestation in the world in the form of beef production. Closer independent scientific study, evaluation and monitoring of the MSPO approach, along with appropriate policy incentivisations and partnerships, will be needed to permit the model to be scaled up in regions at acute risk of biodiversity collapse.

**8** The world requires a new cooperative global pact against deforestation that can empower developing nations rather than alienate them.

In this context, a major question for Western countries is how they can work with, rather than against, regional countries to support them in creating effective mechanisms to eliminate deforestation.

Recent discussions at the EU-level have moved increasingly toward this position, although this has yet to translate into concrete policy. The major opportunity is to develop a comprehensive and cooperative approach to the challenge of deforestation in which industrialised and developed economies of Europe and North America work more closely with producers in South America, Africa and Southeast Asia to develop joint monitoring mechanisms to ensure sustainable production.

Instead of an inconsistent ban on particular commodities, new regulations applied across all relevant commodities should be developed demanding that production practices adhere to government-backed, scientifically-mandated and jointly-enforced sustainability practices based on renewable energy, circular economy and forest conservation principles.

Developed nations should work urgently with producing countries to provide scientific expertise and financial support to ensure that local industries no longer operate in a way which forces animals and the viruses they carry out of their habitats and into new areas inhabited by humans. In the age of COVID-19, this is not a matter that any country can afford to simply to leave to their own devices.

**9** Trade deals should be re-oriented towards recalibrating markets so that they work in the public interest to protect the ecological foundations of markets.

Of course, creating such a global pact on deforestation will not happen automatically. One way of nurturing it into existence is to recalibrate existing trade agreements, or establish new ones, so that they prioritise mutually agreed ecological standards premised on forest protection and clean energy transition. This can underpin new cooperative agreements backed by legislative mandates directed to meet socio-ecological goals, rather than purely to facilitate profit-maximisation incentives.

The MSPO case provides a useful example of how this could be approached. Developed nations should be willing to open their markets to producers which meet environmental standards designed to prevent deforestation. This requires the existence of in-country transparent and enforceable conservation and deforestation standards, which are legally enforceable using national legal powers.

Incentivisation should coexist with the prospect of meaningful penalties. Just as there are opportunities for those who meet environmental standards, there should be consequences for those who do not – loss of access to markets, and the suspension of the ability to supply commodities. Such standards should be flexible enough, though, that they encourage compliance in order to obtain a renewal of trade relations rather than intransigence.

Such standards cannot simply be unilaterally imposed by developed nations, but have to be co-developed with producing countries as partners. They also need to be applied consistently not only toward one commodity, such as palm oil – which is the current EU approach – but to all relevant commodities in order to avoid the risk that commodity substitution would simply displace the drivers of deforestation.

This would also mean providing specific kinds of support to producer countries. In the case of Malaysia, for instance, the EU needs to do more to understand, engage with and support the country's struggle for sustainability, including consideration of: financial support for the MSPO programme allocated to local provinces required to implement them; further subsidies to smallholder farmers to cover sustainability transition costs; joint scientific mechanisms by which to advance and strengthen MSPO standards.

The goal of this approach would be the creation of a set of international and national institutional arrangements, policies and legislative instruments which can be used to effective criminalise deforestation. Such a model could be scaled-up and applied to other regions, including Africa and South America for instance, where its implementation would, however, require a robust approach from the EU to ensure that countries like Brazil are both pressured and incentivised to fundamentally transform their unsustainable beef production practices.

**10** Structural transformation is required within developed, consumer countries to create a new clean industrial paradigm that reduces the drivers of unsustainable consumption-led growth. New stimulus packages are required to kick-start productive investments in this new paradigm.

Tackling deforestation is among the critical 'frontlines' of the breaching of planetary boundaries, but it does not address the deeper drivers of this breach in the form of escalating industrial consumption. This requires deeper structural transformations spearheaded within developed nations, where demand is highest.

The required transformations need to centre around a shift to renewable energy and sustainable production systems in core industrial processes. The ultimate goal is to transition away from fossil fuels using new mechanisms which can function within planetary boundaries. This in turn means the accelerating transition away from oil must be accompanied by a comprehensive transformation of major industrial sectors to create a vibrant new sustainable infrastructure across agriculture, mobility and manufacturing. The orientation of these sectors will need to operate outside of traditional pre-pandemic economic concerns focused purely on profits for shareholders, and instead oriented toward social purpose.

To achieve this may require more extensive government partnerships with the private sector, whether through equity injections or in some cases nationalisation of key industries. In some cases, nationalisation may be the only viable solution – in others, governments may have to create incentives for the private sector to produce goods and services widely needed by society. In many cases, nationalisation of debilitated oil sectors may be the only way for governments to shield their economies as the industry winds down on a science-based timeline. At the same time, this is the occasion to protect, reskill and help transition industry workers into new sustainable and renewable infrastructure projects.

This suggests that fiscal recovery and stimulus packages should direct finances, lending and subsidies to new clean industrial and agroecological enterprises. Just as this should include tackling the core drivers of deforestation by working with producer countries to transform production practices at source, it should also include more broadly tackling industrial agriculture overall, which is responsible for over a quarter of greenhouse gas emissions. That means investing in the comprehensive redesign of global food systems to transition rapidly to agroecological methods.

Within manufacturing and mining, this paradigm shift would require the implementation of new circular economy practices in plastics and mineral recycling to eliminate waste and ensure reuse, sharing and recycling of resources. In the context of an escalating global oil crisis, the plastics sector – which plays a huge role across multiple industries – is particularly vulnerable to disruption. Studies suggest that circular economy principles can be applied to address potential mineral supply bottlenecks in the ramp-up of renewable energy systems.

**11** Monetary reform is required to generate debt-free financing capable of empowering governments to finance this great transition while stabilising the economy.

The remaining question of course is how such a vast programme of systemic transformation can be financed in a time of escalating global financial distress. The role of radical monetary reform can be instrumental here. Rather than borrowing money from the private banking sector and driving up vast levels of public debt, financing can be made available debt-free by public banks (a process that was tentatively begun in the UK by the Bank of England, and although not extended in a comprehensive fashion has retained the potential to do so in a way that would free the UK economy from unsustainable debt levels). In the context of huge deflationary pressures due to the drop in work, wages and jobs, this approach avoids inflation and helps stabilise demand and production, while creating a source of sustainable financing to fund the new infrastructure investments. The more fiscal recovery and stimulus packages can be oriented toward productive investment in the core structures of new sustainable industries, the more rapid would be the ensuing transition.

# Introduction

The COVID-19 pandemic has triggered a global economic crisis which is widely recognised will likely rival or even exceed the scale of recessions over the last 150 years. *(Rogoff, 2020)* The most conspicuous trigger has been the need for governments to pursue unprecedented social distancing measures in order to contain, mitigate or control the impact of novel coronavirus epidemics, and to prevent healthcare facilities from collapsing.

The pandemic has brought about a structural impasse in the current global system, in which either scenario portends significant economic crisis.

If societies completely failed to mitigate the spread of the virus, early worst-case projections indicated a maximum death rate of some 40 million people this year alone. Even if social distancing reduced overall social contacts by 40 percent and social contacts among elderly people by 60 percent, those projections showed that healthcare systems would still be rapidly overwhelmed. *(Elsland, 2020)* Other projections by Australian National University quantified the economic impact. A 'low severity scenario' could see 15 million deaths globally accompanied by an estimated loss to global GDP of $2.4 trillion. The highest severity scenario outlined a cost to global GDP of up to $9 trillion. *(McKibbin & Fernando, 2020)*

These worst-case scenarios will hopefully not be realised due to ongoing suppression and mitigation measures, but those very measures have, in turn, induced their own massive economic consequences. One estimate suggested that global GDP had already fallen by as much as 16 percent since January as a result of government lockdown measures. *(Fox, 2020)* The UN World Food Program warned that as the virus spreads across developing countries, some 265 million could be put at risk of hunger under lockdown measures aimed at curbing the infection rate and preventing healthcare systems collapsing. *(Kretchmer, 2020)*

In other words, the pandemic has brought about a new reality in which either scenario – allowing the virus to run its course without mitigation or pursuing strong social distancing measures to slow or suppress the virus – each produces a

similar catastrophic result for the global economy. This predicament in itself raises fundamental questions about the sustainability of the prevailing economic paradigm in a post-pandemic context, pointing to the necessity to transition to an economy that is no longer structurally-dependent on continued growth.

Further, conventional appraisals of the economic risks tend to view the pandemic through the lens of a prevailing neoliberal orthodoxy, which arguably represents the same economic paradigm that ultimately created the conditions for the current crisis. The conventional narrative points to the necessity of a return to the 'normality' of continued economic growth along the same model.

Yet the role of this paradigm of 'normality' in creating the conditions for the current crisis should play a key role in the economic transition to a post-COVID-19 world, and raises the normative question of what sort of world we wish to inhabit, and whether it is necessary to accept present economic risks as if they are an inevitable and natural feature, or rather a consequence of choices about how we structure our societies – choices which we can therefore change.

This paper argues that a viable post-pandemic economic order cannot be premised on the same principles that generated the conditions that made the pandemic more likely if not inevitable, and which have now locked the economy into a condition of near-permanent structural crisis. As much as the current crisis opens up grave new socio-economic and political risks, it also offers a potential opportunity to transition to a more sustainable, inclusive and prosperous post-capitalist economic order. Yet in order for that transition to work, it is critical to understand the core drivers of the previous prevailing economic model.

This paper will argue firstly that a global pandemic was ultimately inevitable based on the prevailing capitalist global economic model that defines the current structure of industrial civilization. We will begin by cataloguing some of the most compelling and authoritative warnings of this inevitability, and trace this foresight back to the widening scientific recognition that the heightened risk of disease outbreaks is a direct result of the current form of global industrial expansion and economic growth, including in particular the impact of that growth on the world's forests.

Secondly, the paper will examine a largely overlooked failure of neoliberal orthodoxy to recognize the fundamental nature of the economy as embedded in the environment and energy. This grave lacuna, which is being increasingly corrected by the emerging discipline of ecological and biophysical economics, has meant that mainstream financial institutions and policymakers have largely been unable to understand the structural vulnerabilities inherent to the global economy.

Thirdly, this revised analysis of global economic fragilities allows us to reframe the oil price crisis triggered in the context of the COVID-19 pandemic. Rather than the oil crisis appearing simply as a function of unprecedented demand destruction, it appears instead as a reflection of an economic system in environmental overshoot.

Fourthly, this theoretical reframing allows us to undertake a more empirically-informed analysis of the economic crisis as a symptom of a deeper biophysical crisis rooted in the same category of ecological disruption that is destroying pristine ecosystems in particular the world's tropical forests. This in turn brings to light a range of immediate and longer-term risks facing global agricultural production, manufacturing and mining and many other industrial sectors. With a more robust awareness of the global systemic risks, we are in a better position to determine what a viable economic transition should look like that can rapidly facilitate the emergence of a system in which deforestation comes to an abrupt end.

I argue that one of the core frontline strategies to address immediate risks should focus on ending deforestation, which can only be achieved by shifting to sustainable production across key commodities linked to deforestation-linked carbon emissions. As this is arguably one of the pre-eminent current 'frontlines' of the contemporary crisis, it comprises an important focus of this study. This allows me to then focus on some of the broader systemic shifts required to transform the deeper systemic drivers behind deforestation. This includes: shifting to a new economic paradigm based on planetary boundaries and revised notions of prosperity which do not necessitate endlessly growing material flows; recognizing a coordinating role for the state in the economy; monetary reform to avoid debt-expansion; transitioning away from fossil fuels to a new renewable energy system; instituting a new circular economy paradigm across industrial sectors but particularly in mining and energy production; transforming industrial agriculture; transforming manufacturing to become less energy intensive, decentralized and localized.

I argue that governments and the private sector will need to work together urgently on pursuing these interlocking systemic reforms in order to mitigate immediate risks, failure to which will see the economic crisis escalate with ramifying risks across key industrial sectors; the dividends of doing so, on the other hand, will see a rehabilitated, more stable and sustainable economic system begin to emerge, and along with it the seeds of a new form of ecological civilisation.

# 1. Industrial Civilisation and the Systemic Drivers Behind the Pandemic

Prior to the COVID-19 crisis, there have been numerous warnings that a global pandemic would be not merely likely, but inevitable this century. These warnings have been based on scientific research demonstrating the increasing risks of exotic diseases jumping to humans due to the widespread impacts of industrial expansion.

In 2016, the Commission on a Global Health Risk Framework for the Future had warned that the world was bound to experience at least one pandemic before 2100, with a 20 percent chance of experiencing as many as four pandemics within that time-frame. *(National Academy of Medicine, 2016)*

"A range of factors, including increasing population, economic globalization, environmental degradation, and ever-increasing human interaction across the globe, are changing the dynamics of infectious diseases," found the Commission report. "As a consequence, we should anticipate a growing frequency of infectious disease threats to global security."

The report noted that the underlying rate of emergence of infectious diseases has been increasing due to population growth, increasing food production, and consequently greater animal–human interaction. Globalization and urbanization have further amplified the contagion risk from infectious disease outbreaks due to tight-knit trade and travel networks.

Several studies have noted the role of relentless industrial expansion in generating environmental disruptions which have increased the risks of disease outbreaks. Industrial expansion has "produced profound changes in the natural environment, including the mass removal of trees, fragmentation of habitats, and creation of larval mosquito breeding sites, that have allowed the vectors of disease pathogens to thrive," according to a paper led by Dr Robert T. Jones of London School of Hygiene and Tropical Medicine. The study conducted an in-depth review of the scientific literature, finding that "industrial activities may be coupled with significant changes to human demographics that can potentially increase contact between pathogens, vectors and hosts, and

produce a shift of parasites and susceptible populations between low and high disease endemic areas." *(Jones et al., 2018)*

One recent study further points out that the combination of "climate change and climate variability, land use, water storage and irrigation, human population growth and urbanization, trade and travel, and chemical pollution" may have already have impacted on vector-borne diseases carried by ticks or mosquitos, such as "malaria, dengue fever, infections by other arboviruses, schistosomiasis, trypanosomiasis, onchocerciasis, and leishmaniasis." The concept of "global change" refers here to "the complex of environmental changes that is occurring around the world as a result of human activities," and thus directly reflects the inexorable march of global economic growth. *(Sutherst, 2004)*

While these studies focus on vector-borne diseases, "global change" will also drive-up the spread of zoonotic diseases like the coronavirus. There are as many as 600,000 species of mammal virus circulating in wildlife which could potentially spread to humans, but which are largely undetected. The combination of climate change and land use changes driven by industrial expansion is creating geographic range shifts in wildlife which can produce "novel species assemblages and opportunities for viral sharing between previously isolated species. In some cases, this will inevitably facilitate spillover into humans — a possible mechanistic link between global environmental change and emerging zoonotic disease." Even if we manage to keep global average temperatures below 2°C, mammal species will end up gathering in high elevations across biodiversity hotspots which coincide with areas of with dense populations in Asia and Africa. This will lead to a higher risk of novel virus sharing in coming decades, particular from species, bats, suspected as the original source of the coronavirus. *(Carlson et al., 2020)*

Two years before the COVID-19 pandemic, scientists warned that deforestation in Southeast Asia in particular has increased the risk of coronaviruses spreading from bats to humans. The region has suffered the greatest rate of deforestation in the world with a loss of 30% of forest surface over the last 40 years. Deforestation is currently linked to increased agricultural surfaces and poorly-managed urban growth. Demographic growth has accompanied greater pressure on land use, agricultural land and deforestation, with the most common activities being farming, logging, and hunting. The transformation of rural environments, however, has continued to provide an acceptable habitat for a large range of bat species, thus generating a higher diversity of bats and

in turn of bat-borne viruses next to human dwellings. This, the study found, increases the risk of transmission of viruses through direct contact, domestic animal infection, or contamination by urine or faeces. *(Afelt et al., 2018)* A more recent study has corroborated this link, identifying the roles of deforestation and landscape fragmentation in "enabling direct transmission of zoonotic infections" due to increased contact between humans and animals. *(Bloomfield et al., 2020)*

In the context of the preceding studies, deforestation can be viewed as one of the key end-points of expanding industrial processes within the prevailing model of endless economic growth. These end-points include a range of activities linked to industrial societies, including for instance the hunting and killing of bats for mass consumption in China, which have increased the chances of zoonotic viruses jumping to humans. While there is no evidence that deforestation was a direct cause of the COVID-19 pandemic, there is abundant evidence that deforestation increases the risk of the next pandemic. But it does so as part of a wider framework of symptoms of industrial expansion.
The preceding studies demonstrate that forms of industrial expansion involving the destructive encroachment on natural ecosystems and wildlife played a major role in increasing the chances of a pandemic this century. A viable post-pandemic economy needs to, therefore, achieve the following core goal: it should cease resulting in forms of industrial expansion that entail destructive encroachment on natural ecosystems and wildlife.

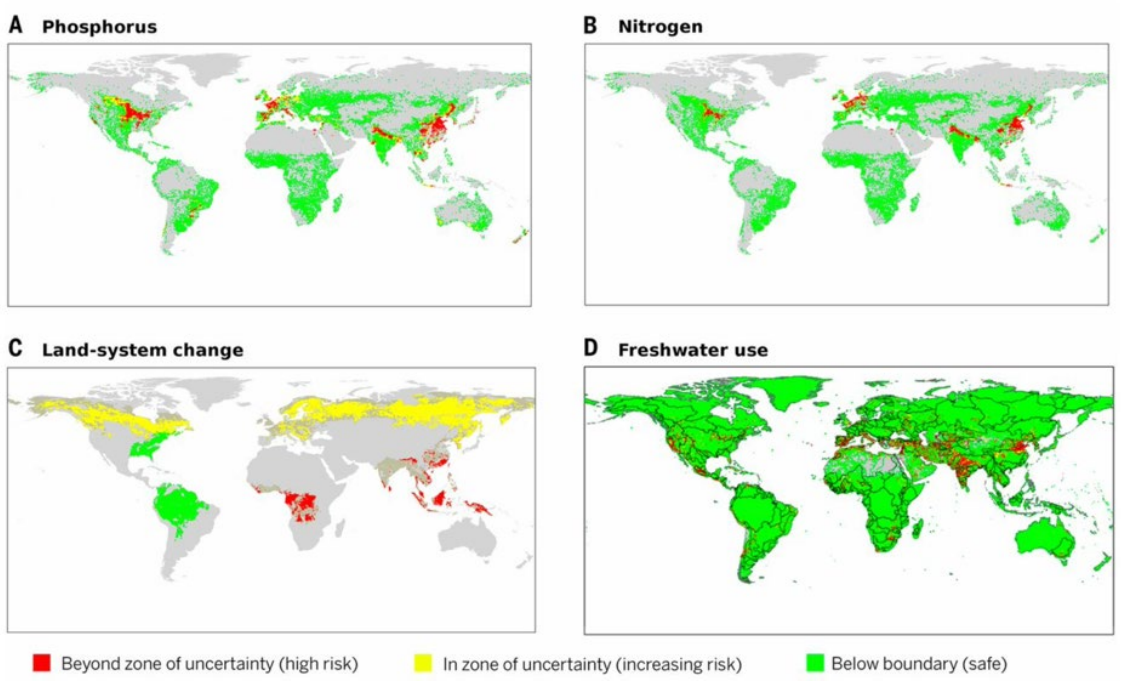
## The Pandemic as a Planetary Boundary Effect

This also allows us to more clearly reframe our understanding of the pandemic as a biophysical crisis resulting directly from relentless forms of global economic expansion which have intensified ecological disruption. The COVID-19 pandemic was a direct consequence of the current global economic model, but it has also generated a systemic crisis that has undermined the operation of that model. It therefore points to the wider context of planetary boundaries delineated by the extent to which human activities under the prevailing economic model have been increasingly endangering the Earth system's capacity to support humanity. Recent work on planetary boundaries has highlighted how the complex intersections between multiple boundary breaching has reduced the 'safe operating space for humanity' within the Earth system. *(Lade et al., 2020)* The pandemic can thus be viewed as a principal symptom of this convergence point between human system activities and disruption of the Earth system, in effect

comprising a tipping point that has forced the current human system into a state of indefinite economic contraction.

The COVID-19 pandemic can then be situated against the wider context of other fundamental planetary boundaries such as climate change and biosphere integrity, with the potential to drive the Earth System into a new state should they be substantially and persistently transgressed. The planetary boundaries framework highlights the predominance of nine such critical planetary boundaries, of which deforestation is one. It is of course, along with these other issues, one of the most intractable and yet most potent drivers of environmental crisis. It is also among the four out of nine planetary boundaries that civilisation was already at high risk of crossing five years ago prior to the COVID-19 pandemic. *(Steffen et al., 2015)*

Other boundaries we were on the brink of breaching at that time included the rate at which species were going extinct, levels of atmospheric carbon dioxide, and the flow of nitrogen and phosphorus into the environment due to industrial agriculture. The further we breach these and other planetary boundaries, the greater the risk of irreversibly driving the Earth into a less hospitable state for humanity.




Five years after this research was published *(Steffen et al., 2015)*, the eruption of the COVID-19 pandemic has exposed the extent to which we are gradually eroding and reducing this 'safe operating space' for human survival, a fact that is evident in the structural impasse we now face: allowing the virus to run through the population leads

to massive fatality rates, collapsing healthcare systems, and crashing GDP; locking down to suppress the virus results in haemorrhaging demand, the contraction of multiple industrial sectors, and crashing GDP.

Both those scenarios entail mass deaths of vulnerable populations over varying levels of time, whether from disease or other socio-economic impacts. And a business-as-usual trajectory heralds more of the same.

A new report from the United Nations Environment Programme (UNEP) thus concludes that the COVID-19 pandemic is essentially a dry-run for what could be an even worse pandemic. The report shows that we should consider COVID-19 as part of a rising trend in zoonotic diseases circulating among animal hosts jumping to humans, driven by core processes of industrial expansion which, if they continue, are bound to trigger the next pandemic. *(Randolph et al., 2020)*

The pandemic therefore confirms that continued deforestation will push human civilisation into a state of retreat. But it is critical to recognise that deforestation acts as one important part of a much wider complex of expanding industrial processes. Furthermore, as the global combination of societal disruption, strained healthcare infrastructures, lockdowns and social distancing have strained normal economic activity, this has put as at risk of ditching seemingly costly environmental commitments. Amidst such pressures, it is no surprise to see that deforestation driven by logging activity has accelerated in Brazil, Colombia, Cambodia, Indonesia, Nepal and Madagascar during the COVID-19 pandemic – partly due to reduced environmental monitoring by authorities and harsh economic consequences amidst lockdown regimes. *(Fair, 2020)*

While enduring one of its dire consequences in the form of the COVID-19 pandemic, progress in addressing deforestation is at risk of reversing – exactly when we need to be immediately putting an end to deforestation once and for all.

According to Professor Kees van Veen, Scientific Director of the Sustainable Society programme at the University of Groningen in the Netherlands, the pandemic can be understood as "another expression of the fact that humanity pushes the planetary boundaries. The growing world population increases the chances that someone somewhere will be affected with a new and dangerous virus. These chances increase due to the fact that humanity exposes itself more and more to different virus 'habitats'

by penetrating the biosphere deeper and deeper. Combined with our very efficient and global transportation networks between densely populated urban areas, viruses can spread very quickly and new accidents are waiting to happen." *(Veen, 2020)*

Yet COVID-19 is not simply a dry-run for the next pandemic – it is also, as executive director of the UN Global Compact Lise Kingo has said, a 'fire drill' for climate catastrophe. *(Harvey, 2020)* Deforestation is among the top drivers of global heating, contributing nearly a tenth of all carbon dioxide (CO2) emissions due to tree cover loss from tropical forests. This is so large that if tropical deforestation were a country, it would rank a third in global CO2 emissions behind China and the United States. CO2 emissions from tropical tree cover loss have been gradually increasing over the last two decades, but especially over the last three years, during which they spiked by 63% on average compared to the preceding 14 years. *(Gibbs et al., 2018)*

The COVID-19 pandemic thus offers us a moment of awakening. We have arrived at an inflection point for the human species. The world needs new global approaches to tackle deforestation as part of a wider systemic effort to rollback the breaching of planetary boundaries. This is necessary to not only avert the next pandemic, but to avert climate catastrophe, along with other forms of biodiversity collapse and ecological crisis. If we fail to do this, humanity faces an intensifying perfect storm of ecologically-linked catastrophes that will increasingly erode the 'safe operating space' for human survival. The COVID-19 pandemic indicates that this process of erosion as we breach planetary boundaries has already begun.

# 2. Deforestation and the Risk of Collapse

The problem of deforestation provides a powerful window into how intractable the processes of environmental destruction really are. These processes are baked into the core structures of production and consumption that sustain industrial civilisation as we know it.

## Deforestation and climate change

When taking into account forest degradation – negative impacts on a forest's structure or function which do not decrease its area size – as well carbon dioxide emissions in tropical peatlands, tropical deforestation actually accounts for as much as 15 percent of total human-induced CO2 emissions. Satellite data for the period 2003-14 shows that tropical forests have now ceased to act as carbon 'sinks', because they emit more carbon than they capture due to deforestation and degradation. *(LSE Explainer, 2018)*

Deforestation also exacerbates heating at local scales within tropical ecosystems. A recent study in Environment Research Letters "found local warming larger than that predicted from more than a century of climate change under a worst-case emissions scenario." The larger the patches of deforestation, the more "extreme" are the local warming impacts. As a result, "the combined effects of deforestation and climate change on tropical temperatures present a uniquely difficult challenge to the long term public health, occupational safety, and economic security of tropical populations." *(Zeppetello et al., 2020)*

But deforestation also endangers critical planetary ecosystems in more direct ways – ways which, if undermined, in themselves could endanger the 'safe operating space' for humanity.

## Deforestation and civilisational risk

Before the development of human civilisations, the Earth was covered by 60 million square kilometres of forest. As deforestation has accelerated due to the human footprint on the planet, there are now less than 40 million square kilometres of forest remaining. Since 1990, industrial expansion has resulted in the loss of some 420 million hectares of forest overall, and the decrease of old-growth primary forest worldwide by over 80 million hectares.

A new study published in Nature Scientific Reports, by physicists Dr Gerardo Aquino of the Alan Turing Institute in London and Professor Mauro Bologna of the University of Tarapacá's Department of Electronic Engineering, came to a stark conclusion based on examining this dynamic. Their study in particular modelled human-forest interactions over the last few decades, along with its potential impact on the viability of human civilisation. Their findings were alarming. "Calculations show that, maintaining the actual rate of population growth and resource consumption, in particular forest consumption, we have a few decades left before an irreversible collapse of our civilisation," they wrote. Tracking the current rate of population growth against the rate of deforestation, the authors found that "statistically the probability to survive without facing a catastrophic collapse, is very low."

At the current rate of deforestation, they projected that all the world's forests would disappear within approximately 100-200 years. As forests provide critical services to the life-support systems necessary for human survival on the planet – including carbon storage, oxygen production, soil conservation, water cycle regulation, support for natural and human food systems, and homes for countless species – "it is highly unlikely to imagine the survival of many species, including ours, on Earth without them." *(Bologna & Aquino, 2020)*

On that scenario, human civilisation would begin to collapse long before the terminal point for planetary-scale forest destruction, potentially well within the next two to four decades. The study authors write: "In conclusion our model shows that a catastrophic collapse in human population, due to resource consumption, is the most likely scenario of the dynamical evolution based on current parameters. Adopting a combined deterministic and stochastic model we conclude from a statistical point of view that the probability that our civilisation survives itself is less than 10 percent in the most optimistic scenario. Calculations show that, maintaining the actual rate of population growth and resource consumption, in particular forest consumption, we have a few decades left before an irreversible collapse of our civilisation." *(Bologna & Aquino, 2020)* This verdict would seem to indicate that there is an over 90 percent probability of a collapse of industrial civilisation due to deforestation alone – this is extraordinarily high.

## Deforestation and agriculture: an European problem

The main driver of deforestation and forest degradation is agricultural expansion, in particular large-scale commercial agriculture – which is responsible for some 80

percent of global deforestation. Between 2000 and 2010, the latter types of agriculture accounted for some 40 percent of tropical deforestation, and local subsistence agriculture for another 33 percent. *(FAO & UNEP, 2020)*

Of the world's major political institutions, the European Union has perhaps been at the forefront of developing new legislative and policy approaches to tackling deforestation. But there are strong grounds to suspect that these approaches are not fit for purpose – and may well even exacerbate the challenge.

Research funded by the EU Commission found that the agricultural expansion behind deforestation is driven by growing demand for key products – like soy, beef and vegetable oils such as palm oil, rapeseed and sunflower. And while the production of such commodities often takes place in developing countries in South America, West Africa and Southeast Asia, the reality is that much of the impetus for the production comes from Western consumers: approximately a third of globally-traded agricultural products linked to deforestation were consumed by European countries between 1990 and 2008. *(Byrne, 2020)*

Thus, it is crucial to recollect that the conceptualisation of deforestation as primarily a problem outside the Western developed world is seriously flawed. New research published in July in the journal Nature Research showed that deforestation rates in EU forests are picking up steam. Forests account for some 38 percent of the EU's land surface area. They are harvested regularly for timber production. But between 2016 and 2018, the loss of biomass due to harvesting increased by 69 percent, compared with the period from 2011 to 2015. The area of forest harvested also increased by 49 percent over these time-scales. The study attributed this upsurge in European deforestation to increased demand for wood for timber and as a fuel, among other wood products. The "abrupt increase" in deforestation poses a serious threat to the EU meeting its climate mitigation targets: "If such a high rate of forest harvest continues, the post-2020 EU vision of forest-based climate mitigation may be hampered, and the additional carbon losses from forests would require extra emission reductions in other sectors in order to reach climate neutrality by 2050." *(Ceccherini et al., 2020)*

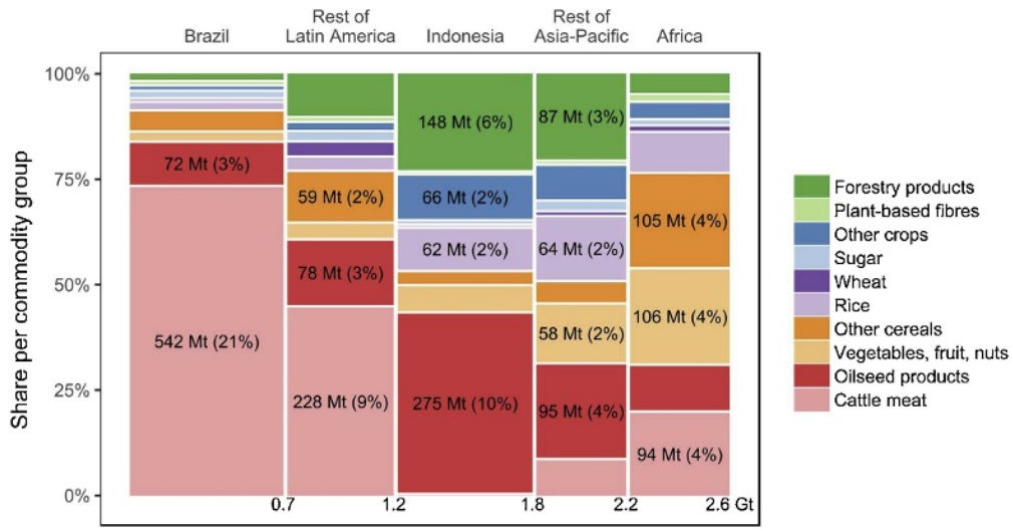
This is hardly the only area of EU complicity in deforestation. For example, some 60 percent of the EU's purportedly 'renewable' energy comes from wood biomass from forests. Yet burning wood for energy typically emits 1.5 times more carbon dioxide than coal and 3 times more than natural gas.

## Deforestation: which commodity?

Yet in its recent efforts to address deforestation since 2015, the EU's overwhelming focus has been not on its own direct complicity in deforestation, but rather on the role of external commodities. The commodity that comes in for the most trenchant criticism – as reflected in the most recent draft EU legal framework to stop deforestation – is palm oil. The proposed draft framework builds on the EU's already existing approach: in 2019, the EU decided to cease categorising palm oil for biodiesel as a renewable energy product, and began implementing a planned phase-out. *(European Parliament, 2020c)*

Palm oil has undoubtedly been one of the major drivers of deforestation, particularly in parts of Southeast Asia. The region has experienced the highest rate of deforestation of any major tropical region, losing 1.2 percent of forest annually, compared to Latin America (0.8 per cent) and Africa (0.7 per cent). At this rate, Southeast Asia will lose three-quarters of its forests and 42 percent of its biodiversity by the end of this century. *(Felbab-Brown, 2013)*

While a major driver, the Western environment movement's preoccupation with palm oil is questionable given that it is by far not the biggest driver of deforestation. In 2019, a major new study in the Global Environmental Change journal found that between 2010 and 2014, beef and oilseed production accounted for over half of carbon emissions from tropical deforestation. The study also quantified precisely which products were more responsible for deforestation than others.



It concluded that the biggest global driver of carbon emissions induced by deforestation is beef production in Brazil, the rest of Latin America, and Africa, accounting for some 34 percent of emissions. The next major driver is from oilseed products such as vegetable oils, at around 20 percent. *(Pendrill et al., 2019)*

The study was able to disaggregate responsibility for emissions in another way. Latin America overall bears the bulk of responsibility, accounting for just under a third of deforestation-linked carbon emissions, with Brazil alone driving a fifth of emissions. Overall, palm oil produced in the Asia-Pacific accounted for 14 per cent – a substantial amount, but still less than half of the former. It is also worth noting that by far the biggest culprit in Asia is Indonesia – one of the world's biggest palm oil producers – accounting for ten percent of deforestation emissions. The other main palm oil Asian producer of course is Malaysia, which would fit within the remaining 4 percent of emissions.

This analysis builds on previous data. In 2013, a report by the European Commission found that between 1990 and 2008, "large imports of soybean products mainly from South America" accounted "for roughly 82 percent of deforestation attributed to the import of oil crops" into the EU. This contrasted with "palm oil imports from Southeast Asia, which contributed about 17 percent of deforestation associated with EU27 oil crops imports, imported primarily from Indonesia and Malaysia." *(Cuypers et al., 2013)*

Armed with this data, we are equipped to realise that the EU's attempt to tackle deforestation primarily through a de facto ban on palm oil for biofuels, while largely neglecting strong legislative and policy action to address rocketing beef and soy consumption, makes little environmental sense.

Indeed, a new study in July revealed that around half of Brazil's beef exports and nearly a quarter of its soy exports to the EU could be from zones which were illegally deforested in the Amazon and Cerrado. The EU is thus directly complicit in the biggest drivers of deforestation, yet has done next to nothing to address this. *(Rajão et al., 2020)*

# 3. Industrial Expansion and Limits to Growth

Ultimately, the problem of a continued high rate of deforestation is directly related to the persistence of demand from the most high-consuming industrialised nations for specific commodities, the production of which is premised on unsustainable practices.

Global industrial agricultural overall is heavily dependent on fossil fuel inputs at every level for fertilisers, pesticides and on-site machinery, as well as processing, packaging, and distribution. For instance, nitrogen fertiliser production uses large amounts of natural gas and some coal, and can account for more than 50 per cent of total energy use in commercial agriculture; while in the UK, oil accounts for between 30 and 75 per cent of energy inputs depending on the cropping system. *(Woods et al., 2010)* This raises the question of how to understand the dynamics of this persistent demand, which is rooted in a specific economic system.

The planetary boundary discourse provides an important context to recognising that the COVID-19 pandemic, far from coming out of the blue, is a direct symptom of a global structure of human activities that has breached multiple planetary boundaries. However, while the planetary boundaries discourse focuses on attempting to quantify the natural Earth system dynamics which, if breached, can destabilise the conditions for human societies to survive and flourish, it does not give specific consideration to the economic models necessary to remain within planetary boundaries. This is due to the wider issue that planetary boundaries frameworks tend to focus on quantifying Earth System dynamics rather than how they interact with the dynamics of human socio-economic systems.

## The biophysical hole in 'doughnut economics'?

The most direct effort to develop an economic model grounded in a sensibility toward planetary boundaries can be found in the 'doughnut economics' approach by Kate Raworth, which attempts to identify how conventional economic activities can be found systematically breaching such boundaries. Raworth's alternative approach is to recognise that economic activity must be intentionally recalibrated through policy incentives and the shaping of markets to remain within those planetary boundaries. She remains

"agnostic" on the question of economic growth or degrowth, arguing that the real issue is to measure economic prosperity through mechanisms other than GDP, which privileges the endless growth in material production and consumption as a fundamental goal, instead shifting toward broader concepts of economic development that need to include other specific indicators of material progress while also encompassing (but by no means limited to) measures of well-being. Rather than fixating on GDP, then, economic activity shifts toward regenerative activities measured by how distributive the economy is. *(Raworth, 2017)*

Despite Raworth's acknowledgement of the 'limits to growth' narrative, however, her analysis tends to occlude systematic analysis of the deeper drivers of constraints on economic growth from biophysical processes related to the energetic and economic dynamics of natural resource exploitation. This occlusion speaks to the overall failure of the planetary boundaries discourse to engage with the scientific literature on the embeddedness of the economy in energy flows relating to the biophysical environment. *(Dearing et al., 2014)* While Raworth does explicitly acknowledge the embeddedness of the economy in energy flows, the lack of a systematic analysis of the relationship between energy and the economy undermines the wider goal to articulate a vision for economics within planetary boundaries. 'Doughnut economics', therefore, while offering a powerful conceptual framework for rethinking conventional economic theory, does not develop a sufficiently complete picture.

## Net energy and limits to growth

The 'limits to growth' thesis traces back originally to a 1972 MIT modelling study which famously warned that business-as-usual scenarios of continued economic and demographic growth would likely breach natural resource limits, leading to the "overshoot" and potential collapse of human civilization, around the period from 2020 to 2050. The overconsumption of natural resources far beyond their rate of renewal, the MIT team's World3 model showed, would escalate costs, diminish returns, and accelerate environmental waste, ecosystem damage, and global heating. With more capital diverted to the cost of extracting resources, less is left to invest in industry and other social goods, driving long-term economic decline and political unrest. An updated analysis published 30 years later found that civilization's growth trajectory had continued to follow the essential scenario projections of the original model. *(D. H. Meadows et al., 2012)*

Since then, several independent studies have confirmed the general accuracy of the model. *(Agboraw & Jones, 2017; Turner, 2008, 2014)* A more recent review tested the model by applying uncertainty analysis and found that despite the World3 model's sensitivity to input error, its forecasted scenarios remain largely predictive: "Trajectories indicating a favourable future for humankind (i.e. without a severe decline in population and resources) stay in areas of low probability." *(Heath et al., 2019)*

The University of Iceland has over the last decade developed a more sophisticated model which takes greater account of human systems dynamics, known as World6. The World6 model demonstrates that "rise and fall scenarios" of industrial civilisation, portending the onset of collapse around mid-century, "are principally right in their analysis as well as the root causes." One recent study based on the model concludes that a business-as-usual scenario will lead to a decline of disruptive nature." *(Lorenz et al., 2018)*

The lead scientist behind the original World3 model, Dennis Meadows, has argued that while the COVID-19 pandemic does not prove the model correct, "increasingly frequent and violent epidemics are consistent with the limits to growth thesis." He argues firstly that the explosive growth of humanity's population and economy has stressed natural ecosystems such as tropical forests, lowering their capacity to self-regulate, and making breakdowns such as epidemics more likely. Secondly, he argues that consumption growth has raised efficiency. While this has permitted the global system to use fewer inputs per unit of output, the overall inputs in real-terms have still continued to increase to drive growth. This has lowered resilience - the capacity to experience an interruption in the supply of a required input without suffering a serious, permanent decline in the desired output. *(D. Meadows, 2020)* In Meadows words:

"Humanity lives on a finite planet that started with a fixed amount of each resource input. To support population and economic growth, consumption of the planet's finite resources has increased. As a result, the resources have been continuously depleted and deteriorated. The fertility of agricultural land, the concentration of mineral ores, the quality of surface waters, and the populations of marine fish are among thousands of indicators that show the long-term average quality of resources is declining. Producing ever greater output from ever diminishing inputs has forced production to become more and more efficient. However, even enormous technological advance has not altered the fact that consumption deteriorates resources."

Although Meadows does not mention capitalism as the operative economic paradigm that explains these dynamics, he acknowledges that the incentive to raise efficiency is spurred on by the profit-motive. This, in turn, is rooted indelibly in capitalist social-property relations, *(Aston et al., 1987; Wood, 1981)* whereby the monopolization of productive systems and the dispossession of producers from ownership and access to these systems incentivizes monopoly owners of productive systems to continually maximize profits. This in turn has severe metabolic implications for the environment due to concomitant escalating resource consumption. *(Ahmed, 2010)*

Meadows notes that the profit motive incentivises monopoly owners of productive systems to maximise production at least cost – that is produce and sell the same output with less input, in order to make greater profits. Yet the imperative for raising efficiency has resulted in the wholesale abandonment of resilient systems in favor of efficient systems with larger scale, less diversity, and lower redundancy. In short, the system is far more vulnerable to ecological shocks and disruption.

## Biophysical economics and the energetic-context of financial crisis

Since the 'limits to growth' model was first published, advances in the study of the interlinkages between the economy and energy have led to the emergence of a new theoretical paradigm called biophysical economics, centred around the concept of Energy Return on Investment (EROI). *(Hall & Klitgaard, 2018)* While biophysical economics tends to neglect the wider biophysical processes explored by the planetary boundaries discourse which identifies how human activities can impinge on and destabilize key natural ecosystems, it focuses on the integral metabolic role of energy flows from the biophysical environment in determining the scope for socio-economic activity. *(Sherwood et al., 2020)*

EROI is designed to measure how much energy is needed to extract energy from a particular resource. What remains is known as surplus 'net energy', used to support goods and services in the economy outside the energy system. The higher the ratio, the more surplus energy is left for the economy. That surplus is running increasingly thin. *(Hall, 2017)* The EROI concept and its applications to economic analysis thus provides a powerful biophysically-grounded insight into the unsustainable endless growth dynamics of the global capitalist economy.

In the early twentieth century, the EROI of fossil fuels was sometimes as high as 100:1: a single unit of energy would be enough to extract a hundred times that amount. But since then, the EROI of fossil fuels has gone down dramatically, as we are extracting fossil fuels from places that are increasingly difficult to reach. *(Court & Fizaine, 2017)* Between 1960 and 1980, the world average value EROI for fossil fuels declined by more than half, from about 35:1 to 15:1. *(Castillo-Mussot et al., 2016)* It is still declining: latest estimates put the value at between 6:1 and 3:1. *(Brockway et al., 2019)* This may have acted as a background 'brake' on the rate of economic growth for the world's advanced industrial economies. *(Murphy, 2014a)* The rate of global economic growth has been slowing down since the 1970s, *(Hall, 2017)* a "phase of declining returns", exemplified by measures across GDP, EROI, along with declining labour and manufacturing productivity. *(Bonaiuti, 2014)*

To make up the shortfall, Bonauiti argues, we have kept the economy growing based on accelerated levels of debt. After the 2008 financial crash, a massive program of quantitative easing (QE) drove global debt even higher than pre-crash levels – barely sustaining a much slower level of GDP growth. But the scale of debt-creation sustaining economic growth far outweighs its own biophysical energy resource base. At some point, Bonauiti warned, this unsustainable heyday was bound to grind to a halt.

The vulnerability of global oil markets added new volatility to this challenge in the EU. In 2005, global conventional crude oil entered a long plateau. *(Inderwildi & King, 2016)* To meet demand the industry shifted to more expensive, unconventional forms. Since then, US shale has supplied some 71.4 percent of global oil supply growth. *(IEA, 2019)*

In February 2020, the Geological Survey of Finland – a Finnish government agency overseeing the EU's mineral resource modelling – published a comprehensive study applying a biophysical economics approach to vulnerabilities facing the global oil sector, and its interconnections with the wider global financial system. The report found that global economic growth in the last few decades, but particularly since the 2008 financial crash, has amounted to a debt-driven "bubble".

With the increasing dependence on unconventional fossil fuels, the underlying costs of extracting energy have risen as EROI has declined. This has been compensated for by increasing the volume of debt in the financial system to maintain growth. As a consequence, most nation state economies have debt-to-GDP ratio that exceeds 90%.

These debt-to-GDP ratios are so high that they have little choice but to sink further into debt to maintain their economies and maintain debt repayments. Although there is "plenty of oil left," it is "increasingly expensive to access", the report warned. Record shale oil production came at higher costs and declining well productivity. Most shale oil companies faced negative cash flow, compensated for by drawing down billions of dollars of unrepayable debt. The report thus assessed that a global peak in total oil production is either "imminent" over the next few years, or may already have happened, possibly in November 2018. The 2005 plateauing of conventional oil production is described as the principal trigger of the chain of events that led to the 2008 global financial crash, and the report warned that "unresolved" dynamics in the global energy system which have been temporarily relieved due to quantitative easing are likely to come to a head "very soon." *(Michaux, 2019)*

Against this background, it is clear not only that the shale oil boom was a bubble inflated principally through debt-financing, but that the COVID-19 pandemic has acted as a pin that burst this bubble. In the wake of the pandemic, oil prices experienced an unprecedented crash into negative territory in April 2020 due to the demand slump. This was followed by a price rally in May, though prices remained lower than normal. The oil industry is experiencing the double blow of demand destruction by the pandemic and the excess supply resulting from excessive production. The excessive oil price volatility is consistent with predictions that as the EROI of a global resource declines, the price relationship between supply and demand becomes increasingly elastic and nonlinear. *(Murphy, 2014b)*

# 4. Biophysical Roots of Global Oil Sector Crisis

The pandemic has thus ground the global oil industry to a halt, and the demand slump will probably last more than a year, even in the most positive scenario. Yet oil wells cannot just be turned on and off. Because they are organic deposits needing pressure to extract, a prolonged shut down risks massive damage to reserves that could be too costly to repair. *(Brower & Sheppard, 2020)* Besides the US shale sector, major producers such as Saudi Arabia and Russia, as well as Europe's North Sea production were all "haemorrhaging cash" due to the unprecedented price drop. *(Reed, 2020)*

## The coming demise of the shale boom

While fears of a resurgence of fossil fuel business-as-usual remain legitimate, a number of industry analysts have recognised that the lower demand scenario may well be a permanent feature of the post-pandemic economic landscape. They warn that by the time we make it to a post-COVID-19 world, much of the global and European oil industry could be permanently decimated. As US shale has experienced a huge wave of well shut-ins, it is entirely possible that the industry could permanently lose 10 percent of production in existing wells even after they are re-opened. *(Kimani, 2020)*

A plausible scenario indicates, then, that the pandemic is likely to keep demand low for a prolonged period of at least a year, during which a significant portion of the oil industry will be force to shut down wells. This would lead to a significant percentage of production capability being permanently lost through the resulting well damage. *(Orland, 2020)*

As a consequence, a number of senior oil industry executives such as Bernard Loomey, chief executive of oil major BP, have acknowledged that this convergence of events could have led to 'peak oil', the point at which maximum production of oil is reached, beyond which production will no longer be capable of increasing. Even if and when demand eventually resurges (and even so, it is likely to do so in a constrained economic context) this might drive exorbitant price hikes, which would then further act as 'brake' on economic growth. In either scenario the implication is that the low EROI-dynamics behind the current oil glut are paving the way for longer-term scarcity. *(Sheppard, 2020)*

This analysis suggests that the conventional supply-demand focused approach, by occluding the deeper biophysical processes underpinning fossil fuel energy production, failed to anticipate the industry's systemic vulnerability in the context of the breaching of planetary boundaries.

## The pandemic and synchronous failure of critical global systems

This ecological and biophysically-informed appraisal of the oil industry crisis triggered by COVID-19 allows us to reframe the crisis as symptomatic of the metabolic rift created by the global capitalist economy's intensifying disruption of planetary boundaries, encompassing both natural ecosystems and energy resources. This in turn allows us to recognize that due to the integral function of energy in economic activities, the oil sector crisis will have further ramifying systemic consequences across multiple interlinked sectors.

The 'synchronous failure' framework developed by political scientist Thomas Homer-Dixon offers the most biophysically relevant approach to conceptualizing the scale of global systemic risk that is now prevalent in the pandemic context. In 2015, he and his co-authors argued that recent global crises, especially several that occurred simultaneously in 2008-2009, revealed an emerging pattern of how multiple stresses can interact within a single social-ecological system to cause a shift in that system's behaviour. Simultaneous shifts of this kind in several largely discrete social-ecological systems can interact to cause a far larger intersystemic crisis, which can then rapidly propagate across multiple system boundaries to the global scale. *(Homer-Dixon et al., 2015)*

The present pandemic fits this model well in demonstrating how a very specific crisis – a disease outbreak in China – has triggered a global-scale pandemic crisis with severe consequences for critical sectors. It has in particular acted as an accelerant for what Homer-Dixon et. all describe as the most fundamental synchronizing factor interconnecting trade, transport, food, manufacturing and other systems: the global energy system.

"Only enormous inputs of inexpensive high-quality energy can create and sustain the unprecedented connectivity and complexity of human civilization, including the connectivity described here among this civilization's diverse component systems.

As a provisional hypothesis, therefore, it seems reasonable to propose that the global energy system helps to synchronize these systems' behavior and to stimulate simultaneous crises within and across them. Other factors such as global trade and transport systems, the Internet, and simultaneous scarcity of multiple resources may also play synchronizing roles, but these factors themselves depend on, and are therefore significantly derivative of, massive flows of energy."

Amplifying feedback loops between these different interconnected sub-systems allows crises in seemingly discrete sectors to generate ramifying consequences across different systems simultaneously, potentially pushing the entire system into global intersystemic crisis which could trigger multiple points of failure.

The destabilization of human systems (HSD) triggered by Earth System disruption (ESD) due to breaching of planetary boundaries can then lead to a further global-scale self-reinforcing amplifying feedback loop, in which the capability of human systems to adapt and reconfigure as ESD escalates is thus undermined. This means that the prospects of further ESD episodes increases as human systems continue to pursue forms of business-as-usual premised on prevailing socio-economic models, continuing to breach planetary boundaries. This decreases human system resilience and increases systemic vulnerability to further ESD. At the next ESD juncture, the HSD consequences are deeper and more wide-ranging than previously. The risk is that without a series of adaptive systemic interventions to minimize and rollback the breaching of planetary boundaries, the self-reinforcing ESD-HSD feedback loop escalates, resulting in an intensifying but protracted cycle of global intersystemic crisis and breakdown. *(Ahmed, 2017)*

This framework allows us to situate the COVID-19 pandemic, then, as a discrete symptom of an ecological rupture in which specific processes of industrial expansion have breached planetary boundaries increasing the risks of exotic diseases jumping to humans and transmitting across tightly interconnected global transport networks; it is also the continuation of a longer-term ESD-HSD crisis process one of whose earlier pivotal stages can be discerned in the intersystemic convergence of energy, food and financial crises around the 2008 global banking collapse.

The ESD-HSD dynamics of that crisis inhibited adaptive human system responses, led to escalating business-as-usual processes that only accelerated the same process

of biophysical disruption, manifesting in the COVID-19 pandemic outbreak just over a decade later. Given that the 2008 financial crash was in itself also the result of a longer-term process of energetic and economic decline in the context of protracted breaching of planetary boundaries exemplified in a 'limits to growth' analysis, the further implication that the global human system has entered a prolonged period of intersystemic decline due to having entered a state of 'overshoot' of these planetary boundaries in the period after around 1970. Both the 2008 financial crash and the 2020 pandemic are conceptually discrete but systemically interconnected symptoms of this process of global intersystemic decline, resulting from the breach of specific boundaries. Whereas the 2008 crash was triggered in the context of planetary boundaries in relation to the global fossil fuel-centric energy system, the 2020 pandemic was triggered in the context of planetary boundaries relating to land use-change.

However, while the ESD-HSD framework identifies global systemic vulnerabilities, it also highlights the scope for human agency in transforming human systems in order to minimize scope for Earth system disruption. At every point in the ESD-HSD amplifying feedback loop, there remains an opportunity for human intervention to strengthen and restructure humans systems to mitigate and avoid further ESD episodes, to adapt to near-term ESD episodes that are already locked-in. The precondition for this, however, is adopting a whole-systems approach toward policy development and implementation, that recognises the interconnections between human systems, and between human systems and the Earth system.

# 5. From Mitigation to Transformation

The preceding analysis provides us a firm basis to begin consolidating our understanding of the systemic risks as the global pandemic unfolds, along with the systemic and policy shifts required to mitigate these risks.

## A whole-systems approach

**Recommendation 1:** A holistic whole-systems approach is necessary to address the drivers of pandemic risk

It can be recognized that several key sectors are at immediate risk as a consequence of the synchronous failure dynamics previously described: the global industrial food system, which is fundamentally dependent on oil inputs at every point – fertiliser, pesticides, on-farm machinery, processing, packaging, transport and distribution; core mining and manufacturing processes that sustain industry as we know it; including the manufacturing of plastics, on which many industries are fundamentally dependent; transport networks which are of course currently heavily dependent on liquid fuels derived from hydrocarbon sources, principally oil. *(Ahmed, 2010)* These risks will be magnified by the internal dynamics of the unravelling of traditional market-centred supply-demand systems. For instance, just-in-time food supply chains cannot survive in their current form in a low demand economic environment. Dairy production is geared toward meeting increasing levels of demand. With demand dropping off, cows trained for high production have been weaned off resulting in reduction of production capacity. Due to the lead-time required to train-up new cows to ramp-up production in the event of a demand resurgence, there is a risk that dairy production will likely be unable to meet demand in the near-term. *(Stokel-Walker, 2020)*

Mitigating against these sorts of complex risks requires recognizing that the supply-demand dynamics dominating the prevailing socio-economic model of human systems do not properly account for the public goods or 'commons' comprising the natural systems which underpin the Earth system.

Contemporary capitalist markets adopt price mechanisms that incentivize profit-oriented dynamics which fail to accurately price in the severe longer-term and intersystemic economic consequences of its own operations. There remain serious questions as to whether it is even possible to measure the value of ecosystem services in order to price them into markets (an endeavour which so far has failed). *(Schröter et al., 2014)* The economies of scale pursued in the context of capitalist markets tend to decrease resiliency in favour of profit-maximization for specific capitalist actors, despite the longer-term implications of doing so being the escalation of Earth system disruption and the concomitant deterioration of the wider conditions of production. In short, capitalist markets are incapable of innovating adaptive responses to Earth system disruption because markets inadequately recognize the global public goods that involve the most severe planetary boundary breaches, such as climate change, biodiversity loss and nutrient pollution. *(Barrett et al., 2007)*

## Intelligent design of markets for a 'life-boat economy'

**Recommendation 2:** Economic policy must shift away from market supremacism to the recognition of a need for intelligent management of markets by political stakeholders: a 'life-boat economy'.

That is why state actors and public authorities need to play a coordinating role designed to recalibrate the operation of markets to ensure that they operate according to new dynamics that go far beyond traditional narrow concerns for shareholder profits, and instead focus on the protection and delivery of public goods. This necessarily requires a transformative approach designed to rollback ongoing breaches of key planetary boundaries. Broadly, the implications of the preceding analysis point to the need for an intersystemic transition encompassing simultaneous transformation of the underlying energy system, the associated socio-economic system, and the twin paradigms of industrial extractivism and market consumerism with which the latter is indelibly linked. This transformation is required both to mitigate immediate risks to existing energy, food, manufacturing, trade and other sectors which may undermine their functioning for societal needs in the near-term, as well as to avoid the longer-term escalation of ESD-HSD feedback loops driving global intersystemic crises.

## Accelerating the transition to a global renewable energy system

**Recommendation 3:** Unprecedented investments in the establishing of a new global renewable energy system are necessary to develop a new sustainable underpinning for global economic activity, but this will not be commensurate with sustaining the old model of 'endless growth'.

There have been calls by key industries such as airlines and automobiles to weaken climate-focused regulation in the wake of the COVID-19 crisis. This can be properly related to a systemic consequence of the ESD-HSD amplifying feedback loop in which an Earth system disruption introduces disruptive human system constraints which undermine its adaptive capacity to respond. The ESD-HSD framework indicates that one of the most critical immediate area for risk mitigation could be in the fossil fuel dependent energy system, upon which so many interlinked complex systems depend for their functioning.

Following the calls of these industries would represent a highly maladaptive human system response within a business-as-usual framework that accelerates the risk of a coming new ESD event. That framework privileges narrow market-centric concerns with a profit-maximization framework dominated by a narrow circle of interests, resulting the sacrifice of global public goods and natural systems to protect returns and minimize losses to incumbent industries principally complicit in the very escalation of ESD.

Therefore, it is imperative to double-down on visions of a sustainable transition away from fossil fuels toward new, renewable energy systems. *(Kemfert et al., 2020)* Such a transition needs to be integrated with emergency economic responses to the pandemic. The longer that the transition to a new sustainable industrial infrastructure is delayed, the bigger the impact of the global oil crisis on critical supply-chains across energy, food and manufacturing.

The integrated nature of the energy-economic transition is also critical. The shift away from fossil fuels entails a fundamental movement away from the traditional energetic source of industrial civilization's capacity for continuous economic growth over decades and centuries. A new EU-funded modelling framework, MEDEAS, demonstrates that while the transition to a renewable energy system is essential due to the internal decline dynamics within the fossil fuel system, doing so does not free industrial civilization from

biophysical constraints. Renewable energy has its own limitations, and cannot sustain an 'endless growth' economic paradigm due to a ceiling on EROI values which is far lower than what was achievable during the early twentieth century heyday of fossil fuel production. Failing to rapidly adapt global economic dynamics to this new energy reality could trigger "a widespread systemic global socioeconomic and environmental crisis… in the next few decades." *(Kemfert et al., 2020)*

The new energy reality is one of much lower levels of 'net energy' than available in the earlier stages of the dawn of industrial civilization. This reality applies whether we remain dependent on fossil fuels – which entails an accelerating trajectory of climate change and ecological disruption – or transition to renewables. While the former constitutes a declining supply, the latter at least heralds the prospect of transitioning to a more sustainable resource which, if approached correctly, can continue to sustain healthy societies. *(Bardi, 2014)*

This still requires confronting the possibility that continued GDP growth may no longer be possible in a post-pandemic context. While the debate on 'degrowth' rages on, emerging biophysical evidence indicates that due to the ESD-HSD dynamics explored above, the global economy will inevitably experience a form of contraction, whether this occurs as a result of the consequences of global intersystemic crises or through a planned, coordinated process of adaptive human system responses.

This will lead to a greater need for revised notions of prosperity beyond GDP that uphold 'well-being economies' within planetary boundaries, along with a much greater concern for the true costs of natural resource exploitation. To some extent this process is beginning. Around the world, city, state and national leaders are pushing forward innovative economic recovery plans designed to generate newfound ecological resilience, mitigating climate risks and generating greater racial, gender and economic equity. These plans, while nascent, must be scaled-up rapidly at emergency pace. *(Sawin & Ceballos, 2020)* This means that stimulus packages need to facilitate a longer-term re-design of our economies from the ground up – a shift toward new cooperative and inclusive approaches to economic policy the 'laissez faire' economics of 'each individual for themselves', to new, cooperative and inclusive approaches premised on recognising the inherent interdependence of individuals, societies, other species, and their constitutive ecosystems. This requires taking a twin approach: a 'life-boat economy'

approach designed to mitigate immediate risks; and a rapid transition to sustainable and resilient economic foundations. Such clean fiscal recovery packages can create greater resilience to looming threats like climate change, while also having the most potential in driving strong economic performance within planetary boundaries and biophysical constraints. *(Hepburn et al., 2020)*

## Tackling deforestation by transforming production and consumption

**Recommendation 4:** The only viable way to tackle deforestation is by transforming production practices across all relevant commodities, rather than singling out any one in particular.

The shift to a new economy requires moving to an economic paradigm that no longer privileges narrow profit considerations as a predominant overarching structure, but instead recalibrates markets to work in the public interest. This requires a fundamental transformation in production and consumption habits to rollback patterns of activity that are bound up with processes of industrial expansion which can be traced directly to complicity in the biophysical processes driving the heightened risk of disease outbreaks.

As we have seen, perhaps the most urgent area of transformation to reduce the risk of the next pandemic is deforestation. While commodities like palm oil have been rightly criticized for production techniques causing deforestation, in terms of practical policy, legislation and certification programmes, considerably less attention has been played to much the larger drivers of deforestation in the form of beef and soy. Furthermore, most of the policy focus to rectify these challenges have been on addressing consumption through proposed boycotts of specific commodities rather than transforming production processes.

In particular, in terms of practical policy legislation, deforestation concerns have been overwhelmingly fixated on palm oil at the expense of other commodities which not only have proven roles in breaching biophysical boundaries, but in somes cases (such as beef) considerably larger roles – without however eliciting commensurate action. For instance, the European Union has banned palm oil for biodiesel as part of an effort to tackle deforestation but has done little about its own consumption habits which encourage the unsustainable production of other commodities such as beef, which is implicated more than double the levels of deforestation. The EU's singling out of palm oil while giving a free-pass to other commodities is therefore misguided. *(Pendrill et al., 2019)*

This suggests that the predominant strategy on deforestation remains constrained within the narrow interests and market dynamics of the EU's incumbent industries, rather than being motivated by a genuine desire to curb the intersystemic causes of deforestation. The policy has favoured Europe's domestic biofuels industries and oilseed producers while doing nothing to curtail imports of beef or soy which by far play the largest role in driving rates of tropical deforestation, principally in South America. *(Erixon, 2012)*

Yet the shift to alternative domestic sources of biofuels – such as soy and rapeseed – would still produce carbon emissions at a higher level than that of traditional fossil fuels. *(Crisp, 2016; T&E, 2016)* In general, agro-economic modelling studies reveal that indirect land-use (ILUC) carbon emissions from food-based biofuels "can be expected to be significant compared to potential savings." *(Baral & Malins, 2016)* The other problem is that biofuels at any level of analysis can never contribute to anywhere near the same levels of resource efficiency as possible with oil and gas. Due to EROI levels which are orders of magnitude lower than fossil fuels, it needs to be recognized that biofuels can never function to simply replace oil for transport. If this was done, they would be required in such large quantities that it would result in exorbitant and even higher levels of energy input than with fossil fuels. This does not mean there can be no role for biofuels at all, but it suggests that in general, biofuels should be relegated to the role of a potential bridge fuel and stop-gap measure, and only on condition of achieving absolute sustainability in production. *(Gomiero, 2015)*

**Recommendation 5:** Incentivisation structures, rather than commodity boycotts, are required to accelerate the most effective forest protection approaches. Boycotts alone can escalate deforestation.

This is further complicated by the problem that according to the International Union for Conservation of Nature (IUCN) an outright on ban on palm oil in particular – which is the EU's current policy on biofuels – would likely cause more harm to the environment by displacing global biodiversity losses instead of stopping them. Without reducing underlying sources of demand, demand would instead switch to alternative commodities which, however, use far more land end energy than palm oil, therefore potentially driving far greater rates of deforestation *(Meijaard et al., 2018)*

This is because a palm oil ban would increase the production of other oil crops, such as rapeseed, soy or sunflower, which require up to nine times as much land to produce than palm oil, in order to meet the global demand. According to a recent study in Nature Sustainability, these crops store less CO2 than palm oil, require more fertiliser and pesticides and have lower productivity and shorter lifespan compared to oil palms. This body of research confirms that the only sensible scenario is to ensure sustainable production processes at source. *(Parsons et al., 2020)*

Similarly, a major study in Annual Review of Resource Economics published this year has provided further corroboration for these findings. The Annual Reviews study led by German scientists is worth noting as it is one of the most authoritative analyses of the best scientific literature to date. It confirms that the key challenge is related to the efficiency of palm oil, relative to land, water, energy and fertiliser inputs: "The global demand for vegetable oil will continue to grow. Against this background, banning or curbing oil palm cultivation is not a realistic option. Given oil palm's high land productivity, meeting the rising demand only through other oil crops would entail even more land-use change and natural habitat loss." *(Qaim et al., 2020)*

A boycott-only approach also tends to incentivise producers to find ways to circumvent the boycott, by accessing other markets (such as India and China), where environmental regulations are far less stringent. This once again undermines the entire point, and increases the risk of continued deforestation. Such findings about the conventional approach have now been modelled. An extensive modelling study in the Proceedings of the National Academy of Sciences attempted to assess the consequences of "market-mediated" interventions such as bans or boycotts designed to limit palm oil production or consumption, and whether these would actually stop deforestation. The study found that "simply limiting palm oil production or consumption is unlikely to halt deforestation" in Malaysia and Indonesia, "in the absence of active forest conservation incentives… Targeting just a single driver of deforestation… opens room for other drivers of deforestation to operate more actively in the absence of a forest protection plan." *(Taheripour et al., 2019)*

If bans or boycotts are not a viable solution, then it is time to face up to the fact that the conventional policy toolbox has failed. To stop the scourge of deforestation requires a much more joined-up approach, one which approaches the global challenge holistically.

This also highlights the necessity of homing in on the solution which all these studies point to consistently: transforming production at source.

While the global picture on deforestation is alarming, there are also emerging signs of change. Our task must be to leverage these indicators and accelerate them – before we hit catastrophe.

**Recommendation 6:** Voluntary sustainability programmes are inadequate. Enforceable, mandatory legislation within producer countries is necessary to help criminalise practices that lead to deforestation.

According to the 2020 State of the World's Forests report, the rate of global deforestation has been declining over the last few decades. From the 1990s to the period between 2010 and 2020, the net loss of forest area decreased from 7.8 million hectares per year to 4.7 million hectares per year. One reason for this is that despite ongoing deforestation, new forests are also being established, both naturally and through deliberate planning.

But the rate of deforestation also appears to have declined in real-terms. In the 1990s, the rate of deforestation was around 16 million hectares per year. Between 2015 and 2020, this had declined to an estimated 10 million hectares per year. Around the same period, according to data from the UN Environment World Conservation Monitoring Centre, the area of forest allocated to protected areas has also increased from around 4.2 million hectares in 1992, to about 8.2 million hectares in 2015. But these are not grounds to be sanguine. In absolute terms, the UN report shows that global forest area still decreased overall by a colossal 178 million hectares between 1990 and 2020, an area about the size of Libya. *(FAO & UNEP, 2020)*

The other problem is that simply offsetting deforestation with new reforestation is not a viable solution – as doing so often fails to solve the problem of species losing their homes; reforested land might consist of pristine forests being replaced with commercial plantations; and forest regrowth does not necessarily lead to full ecosystem and biodiversity recovery. *(Pearce, 2018)*

Nevertheless, a decade ago the Annual Review of Environment and Resources found evidence that part of the reason for the decrease in the rate of deforestation (despite it still being "alarmingly high") is that "a handful of tropical developing countries

have recently been through a forest transition – a shift from net deforestation to net reforestation." These forms of transition encompassed a range of different approaches within different regions. In Central America, a common approach was reforestation on abandoned land. In South America, private actors drove new forest plantations. In Asia, land-use policies restricting activities on forestlands and agricultural changes helped contribute to forest regrowth.

But the study warned that forest transitions alone would not be sufficient to protect primary forests. Land-use zoning – segregating off different areas of land for different agricultural, industrial, conservation and other purposes – was recommended, along with changes to the demand side in the form of "ecoconsumerism" and "new corporate environmentalism", to accelerate "a transition in production systems and orient consumption toward less land-demanding products." A failure to execute such changes would render the positive wins from forest transition processes negligible and end up driving increasing rates of deforestation. *(Meyfroidt & Lambin, 2011)*

The latest data produced from the Global Forest Watch project run by the World Resources Institute confirms that amidst the welcome evidence that slowing deforestation is perfectly possible even with a mix of inadequate policies, we are on the cusp of losing even those potential gains. The data shows that primary forest loss was 2.8 percent higher in 2019 than the previous year.



The data also confirms that the country that lost the most primary forest in 2019 was Brazil – where during the COVID-19 pandemic, deforestation has continued to accelerate. Palm oil producer Indonesia comes third on the list of the top 10 tropical countries experiencing the most primary forest loss, and the other major Asian palm oil producer, Malaysia, comes sixth. *(Weisse & Goldman, 2020)*

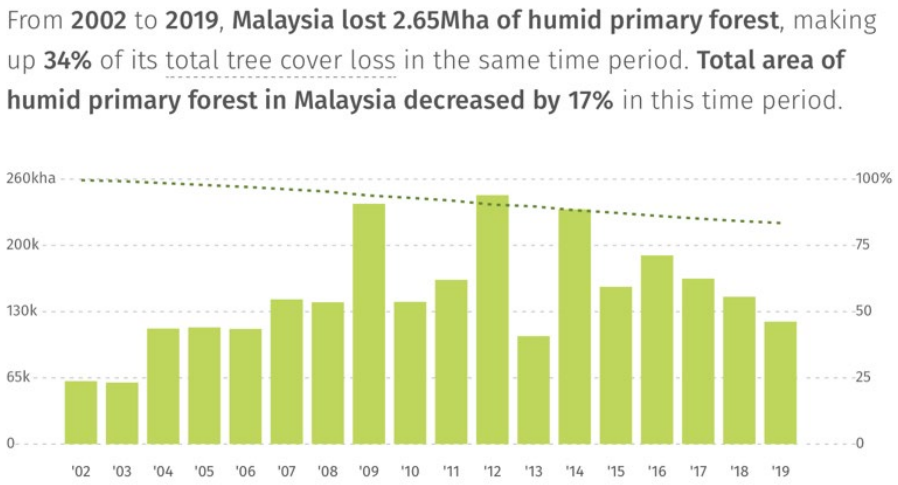
But while Brazilian deforestation has accelerated, there has been significant success in reducing the rate of forest loss in Indonesia and Malaysia. "In positive news," noted Global Forest Watch, "primary forest loss in Indonesia decreased by 5 percent in 2019 compared to the year before, marking the third year in a row of lower levels of loss. Indonesia hasn't seen such low levels of primary forest loss since the beginning of the century."

Similar marked declines can be seen in Malaysia, where the decrease in the rate of primary forest loss also occurred year-on-year for three years. The decline also appears to be far more steady over a longer period of time, but especially over the last 3-5 years – and the absolute scale of deforestation is far below the level of Indonesia's, which is a larger producer. *(WRI, 2020)*

According to Global Forest Watch, the most likely drivers of this welcome decline include local forest conservation policies such as "increased law enforcement to prevent forest fires and land clearing, and the now-permanent forest moratorium on clearing for oil palm plantations and logging." *(Weisse & Goldman, 2020)*

Studies which have documented a link between oil palm expansion and deforestation have confirmed a slow-down in the rate of deforestation linked to poverty alleviation and industrialisation. In Malaysia, while the oil palm area continued to expand from 1973 to 2010, "deforestation began to slow down from the mid-1980s, with oil palm planting shifting from newly cleared forest land to land that had been previously used for other agricultural commodities" such as rubber, coconut, and cocoa. The decrease in demand for land has been associated with a shift toward an industrialised and service economy, but it is also plausible that Malaysia's early pledge to protect the country's forest cover at the 1992 Rio Earth Summit played a key role in slowing deforestation overall. *(Miyamoto et al., 2014)*

Most of the more recent progress has coincided with the implementation of a new national sustainable certification scheme, Malaysia Sustainable Palm Oil (MSPO). Established in 2015, after a new government came to power in 2018, it was announced that the scheme would be made mandatory by the end of the year – making it the world's first government-backed, legally-enforceable sustainable certification programme for palm oil. Under the programme, the government would enforce a moratorium on palm oil expansion to protect forest cover at 50 percent, accompanied by enforced mandatory sustainability standards aimed at certifying 100 percent of Malaysia's palm oil production. *(Gelski, 2018)* This was the latest and most robust measure in a series of increasing efforts to impose more stringent sustainability regulations, which began as entirely voluntary – and it was the first time a government had made such regulations mandatory.




As a national mandatory scheme, MSPO differs quite fundamentally from the more well-known corporate-backed sustainability certification schemes such as the Roundtable on Sustainable Palm Oil (RSPO). The RSPO scheme is an industry-led scheme supported by some of the largest companies in the world involved in palm oil production from Unilever to Nestle. This also means that it is inherently designed to cater for the technical larger producers, making it far more expensive, complex and inaccessible for smallholder farmers who manage some 50 percent of the worldwide oil palm land. However, it is also by its very nature a purely voluntary scheme, which therefore means that its standards, though widely recognised as technically robust, are not always consistently enforceable or enforced.

Although the RSPO standard is therefore inadequate, some other recent criticisms fall short. For instance, one new study by Italian biologist Roberto Gatti in Science of the Total Environment examined satellite data to find that over the last 30 years, RSPO certification has ended up sanitising long-term deforestation. The study assessed that most of currently certified production in Sumatra and Borneo are located in areas that were, in the 1990s, biodiverse tropical forests that were large mammal habitats. Therefore, the study claims that sustainability certification schemes like RSPO are not genuinely 'sustainable,' and that sustainable palm oil does not really exist. Therefore, it concludes that such schemes function only to sanitise continued unsustainable expansion of palm oil and further deforestation. *(Cazzolla Gatti & Velichevskaya, 2020)*

While there are certainly cases of industry malpractice which the RSPO has failed to address – arguably due to its character as a self-managed voluntary bureaucracy – these are weak conclusions which do not follow from the evidence assessed, and are derived from an arbitrary definition of sustainability. RSPO was created in 2005 precisely to address the reality of decades of deforestation. Gatti and Velichevskaya concede that much of this deforestation may not in fact have been related to palm oil at the time. Many oil palm plantations on these degraded lands were also established prior to RSPO, whose remit is precisely to manage these lands sustainably going forward while preventing new forest degradation. The study thus says little about the actual effectiveness of RSPO's current practices. Notwithstanding this misfire, the persistence of reports of malpractice by some RSPO members demonstrates the problem with relying on a purely voluntary standard. This is why a mandatory, legally-enforceable standard such as MSPO is necessary.

**Recommendation 7:** Inclusive and cooperative partnerships between producer and consumer countries are critical to ensure that successful local approaches are rapidly supported and scaled.

Preliminary indications from independent observers further suggest that the conservation and biodiversity protection mechanisms introduced under the new Malaysia Sustainable Palm Oil (MSPO) certification scheme have been effective when properly applied. Canada-based conservationist Robert Hii was able to visit some MSPO certified plants in Sarawak Oil Palms Berhad in Sarawak in 2017. He noted that these were "best of category" cases, but concluded that "if the operations I saw are

any indication of what Malaysian sustainable palm oil would look like under the MSPO scheme, there is no doubt about its sustainability." He was also impressed to see "the conversion of waste products to fertilizer and biomass to power its operations and the use of natural pest control. Most notable of what I observed was the measures taken to ensure the living standards of migrant workers and their families." But he warned that while the MSPO standard itself seemed promising, the biggest challenge was scaling it up nationally to ensure adoption from smallholder farmers for whom certification was widely seen as a costly and unnecessary bureaucratic expense. *(Hii, 2017)*

Hii does not argue that the MSPO scheme is perfect and has pointed out many important areas for potential improvements. But he also points out that one of the challenges facing the Malaysian government is that it does not directly control land-use policies at a federal level, which are executed by each of the country's thirteen local states. In particular, the Borneo states of Sarawak and Sabah have even greater say on land-use matters. Other states such as Penang or Perak are poorer and working through different stages of development compared to other parts of the country. These complex internal dynamics create political challenges in the implementation of federally-mandated sustainability policies. *(Hii, 2019)*

This progress should not justify complacency, but may point to a new model of sustainable conservation that can help create newfound resilience to disease outbreaks while bringing production and consumption patterns back within the 'safe operating space' delineated by planetary boundaries. Rates of deforestation not only in Southeast Asia but in South America and across the world remain unacceptable and dangerous. The combination of industrial agriculture, megadams, mining and logging across multiple commodities continue apace and require a far more integrated, cooperative approach premised on a fundamentally different economic mindset.

This calls for a comprehensive and cooperative approach to the challenge of deforestation in which industrialised and developed economies of Europe and North America work more closely with producers in South America, Africa and Southeast Asia to develop joint monitoring mechanisms to ensure sustainable production. Instead of an inconsistent ban on particular commodities, new regulations should be developed demanding that production practices adhere to government-backed, scientifically-mandated and jointly-enforced sustainability practices based on renewable energy,

circular economy and forest conservation principles. Developed nations should work urgently with producing countries to provide scientific expertise and financial support to ensure that local industries no longer operate in a way which forces animals and the viruses they carry out of their habitats and into new areas inhabited by humans. In the age of COVID-19, this is not a matter that any country can afford to simply to leave to their own devices. In this respect, the MSPO model may provide a useful framework that can be strengthened within Malaysia and applied to other production processes outside Malaysia in areas at risk of deforestation. The MSPO model could provide a powerful test-case for a viable sustainable conservation approach that could be applied not only in other areas of Southeast Asia, but also in South America and elsewhere to address deforestation challenges facing other oilseeds and, of course, the biggest driver of deforestation in the world in the form of beef production. Closer independent scientific study, evaluation and monitoring of the MSPO approach, along with appropriate policy incentivisations and partnerships, will be needed to permit the model to be scaled up in regions at acute risk of biodiversity collapse.

## Toward a cooperative global pact against deforestation

In this context, a major question for Western countries is how they can work with, rather than against, regional countries to support them in creating effective mechanisms to eliminate deforestation.

**Recommendation 8:** The world requires a new cooperative global pact against deforestation that can empower developing nations rather than alienate them.

Of course, in some cases – such as Brazil where the government is brazenly and openly accelerating deforestation – a far stronger approach is required in place of the current policy of abject capitulation and complicity. The question is how to balance this in the form of a more coherent set of policies.

What this means is that a fundamental sea-change is required in the global approach to tackling deforestation, and it requires a new focus on engendering institutions of global cooperation on deforestation, rather than competition in commodity production.

The EU is beginning to wake-up to the failure of its previous approach, but it has yet to come up with a more coherent alternative. A paper published last month by

the European Parliament's Directorate-General for External Policies of the Union, for instance, admitted that it would be "more effective and less costly" than banning palm oil imports, if major palm-oil producers such as Malaysia and Indonesia were to "implement a moratorium on deforestation." *(European Parliament, 2020a)*

What is unclear is what follows from this about-face. Another recent report from the

European Parliament's Committee on Agriculture and Rural Affairs throws some light on this. The report encourages "inclusive partnerships" with the global south to prevent deforestation, but also calls for new legal powers and certification standards that would effectively criminalise deforestation. Yet there is little or no explanation as to how this could work in practice. And the EU still has a very poor understanding of developments on the ground. *(European Parliament, 2020b)*

At one point, for instance, the Directorate General report dismissed the positive impact of certification schemes in Indonesia and Malaysia based on outdated research. Claiming that "less than one-third of palm-oil production is certified" in these countries, the report concluded that such efforts therefore "fall short of their stated goals". While there is no doubt that these schemes require urgent improvement and scaling up, as we have seen above, progress in certification in Malaysia is actually double the EU's outdated estimate, and the MSPO certification scheme is far more substantive than this document acknowledges.

This gap between perception and reality highlights the real problem in the EU's approach – a lack of sufficient scientific and diplomatic engagement with key producer countries, especially where progress is being made. Not only does this lead to an Eurocentric conflation of countries like Indonesia and Malaysia under a single umbrella - which is simply unjustifiable - but it also leads to a fatal lack of understanding of the challenges going on at the local level within such developing nations.

EU parliamentarians and officials need to do more to fill this gap. What is meant by an 'inclusive partnership'? What kind of legal penalties are proposed and how would they be imposed? How can Europe encourage developing nations to co-operate on common standards of sustainability – especially given its own double-standards on deforestation?

## Recalibrating markets to work in the public interest

**Recommendation 9:** Trade deals should be re-oriented towards recalibrating markets so that they work in the public interest to protect the ecological foundations of markets.

One part of the answer to these questions could be recalibrating trade agreements, or establishing new ones, so that they prioritise mutually agreed ecological standards premised on forest protection and clean energy transition. Ultimately, this requires recognising that markets as currently structured are functionally incapable of addressing the complex emergencies that characterise the global commons. There is, in short, no laisser-faire 'market solution' to the escalating crises that have emerged from the breaching of planetary boundaries. In fact, those crises have arisen in the context of those markets. There is, therefore, an urgent need for governments to recalibrate and restructure markets through new cooperative agreements backed by legislative mandates so that they are directed to meet socio-ecological goals, rather than purely to facilitate profit-maximisation incentives.

Tackling deforestation in the context of palm oil provides some specific opportunities for such an approach to be explored, tested and then scaled-up if successful. For those palm-oil producers which meet environmental standards designed to prevent deforestation, intergovernmental agencies like the UN and the EU along with their most powerful member states should, as an economic carrot, open their markets. For this to work, of course, requires transparent and enforceable conservation and deforestation standards within the respective countries. To achieve this will require the UN, the EU and others to work closely with countries to develop a joint mechanism for determining rigorous sustainability standards, one that is legally enforceable using national legal powers. Yet it is equally important that incentivisation coexists with the prospect of meaningful penalties. Just as there are opportunities for those who meet environmental standards, there should be consequences for those who do not – loss of access to markets, and the suspension of the ability to supply commodities. Such standards should be flexible enough, though, that they encourage compliance in order to obtain a renewal of trade relations rather than intransigence.

The EU's call for a consistent set of global certification standards in this regard makes sense. Yet such standards cannot simply be unilaterally imposed from the west, but have to be somehow co-developed with producing countries as partners. They also need to be applied consistently not only toward one commodity, such as palm oil – which is the current approach – but to all relevant commodities in order to avoid the risk that substituting vegetable oils would drive even greater rates of deforestation, especially without any sustainability certification systems in place to avoid this. This may well require a hub and spokes model, with multiple local or regional certification systems in place backed by local national government enforcement powers, and supported by a transnational governing structure established in partnership between the respective national government and other supporting partners such as the EU or the UN.

The case of Malaysia could provide a test-case for how a viable local-based certification model might work, with wider implications for EU and western engagement with the developing world. To make real progress, the EU needs to do more to understand, engage with and support the country's struggle for sustainability. As CSPO Watch's Robert Hii has noted, Malaysia's federal government is struggling on three fronts – firstly, to empower its MSPO national enforcement capabilities in local provinces which traditionally hold the bulk of legislative land-use powers; secondly, to incentivise smallholder farmers transitioning to mandatory sustainable certification who often perceive it as a major cost-burden; thirdly, to ensure that its standards are as environmentally robust as possible.

All these are areas where a more cooperative approach could open up new opportunities for the EU and other international agencies to provide support to Malaysia in speeding its goal of achieving 100 percent sustainability for palm oil production: financial support for the MSPO programme allocated to local provinces required to implement them, along with further subsidies to smallholder farmers, could be a sound investment; a joint scientific mechanism by which to advance and strengthen MSPO standards would also be important; along with more integrated mechanisms to leverage Malaysia's recent moves to increase transparency by publishing maps of all palm oil concessions to support better international monitoring efforts. *(Raghu, 2019)*

Success with the MSPO model may well provide a case study of a set of international and national institutional arrangements, policies and legislative instruments which can be

used to allow the EU and international agencies to monitor and respond in real-time to the risks of deforestation, while simultaneously working closely with local producers to enforce nationally-backed laws which essentially criminalise deforestation.

Such a model could be scaled-up and applied to other regions, including Africa and South America for instance, where its implementation would, however, require a robust approach from the EU to ensure that countries like Brazil are both pressured and incentivised to fundamentally transform their unsustainable beef production practices.

This would protect the environment, help halt deforestation and benefit Western consumers. It would also help the economies of the global south, and support smallholder farmers.

**Recommendation 10:** Structural transformation is required within developed, consumer countries to create a new clean industrial paradigm that reduces the drivers of unsustainable consumption-led growth. New stimulus packages are required to kick-start productive investments in this new paradigm.

But ultimately, this brings us back full circle. We have addressed the potential for new approaches to tackle deforestation within producer countries. But what about rolling back the industrial consumption machine that is driving the inexorable rise in demand? Is it possible to recalibrate markets in order to slow down our overall civilisational trajectory of endless growth, which is the primary reason we are breaching planetary boundaries with abandon?

Tackling deforestation is among the critical 'frontline' issues related to the breaching of planetary boundaries, but it does not address the deeper drivers of this breach in the form of escalating industrial consumption. This requires deeper structural transformations spearheaded within developed nations, where demand is highest. For Western environmentalists, the inordinate focus needs to move away from a preoccupation with developing nations toward a greater focus on the biggest industrial economies in the world. As the preceding discussion shows, this does not mean neglecting the former, but it does mean recognising where the deeper drivers of the crisis really begin: within the centres of power within the global system.

The required transformations need to centre around a shift to renewable energy and sustainable production systems in core industrial processes. The ultimate goal is to transition away from fossil fuels using new mechanisms which can function within planetary boundaries. This in turn means the accelerating transition away from oil must be accompanied by a comprehensive transformation of major industrial sectors to create a vibrant new sustainable infrastructure across agriculture, mobility and manufacturing. The orientation of these sectors will need to operate outside of traditional pre-pandemic economic concerns focused purely on profits for shareholders, and instead oriented toward social purpose.

To achieve this may require more extensive government partnerships with the private sector, whether through equity injections or in some cases nationalisation of key industries. In some cases, nationalisation may be the only viable solution – in others, governments may have to create incentives for the private sector to produce goods and services widely needed by society. In many cases, nationalisation of debilitated oil sectors may be the only way for governments to shield their economies as the industry winds down on a science-based timeline. At the same time, this is the occasion to protect, reskill and help transition industry workers into new sustainable and renewable infrastructure projects. *(Aronoff, 2020a)*

This suggests that fiscal recovery and stimulus packages should direct finances, lending and subsidies to new clean industrial and agroecological enterprises. Just as this should include tackling the core drivers of deforestation by working with producer countries to transform production practices at source, it should also include more broadly tackling industrial agriculture overall, which is responsible for over a quarter of greenhouse gas emissions. That means investing in the comprehensive redesign of global food systems to transition rapidly to agroecological methods. These will involve increasing efficiency of industrial and conventional practices to reduce industrial inputs; where possible replacing industrial methods with organic and biodynamic agriculture including the use of crop rotations, nitrogen-fixing covercrops and natural controls for pests; redesigning agroecological systems entirely to remove key yield-limiting factors; shifting to more local forms of production to decrease the gap between growers and consumers; and springboarding from these changes toward global food system transformation to reduce global ecological footprints. *(Gliessman, 2016)*

Within manufacturing and mining, this paradigm shift would require the implementation of new circular economy practices in plastics and mineral recycling to eliminate waste and ensure reuse, sharing and recycling of resources. In the context of an escalating global oil crisis, the plastics sector – which plays a huge role across multiple industries – is particularly vulnerable to disruption. Studies suggest that circular economy principles can be applied to address potential mineral supply bottlenecks in the ramp-up of renewable energy systems. *(Bardi, 2014)*

However, a successful circular economy model requires an integrated approach across multiple sectors that would conjoin the transition to renewable energy, mineral recycling and plastics recycling in the context of a transformed oil sector focused on sustainable petrochemicals production. *(Service, 2019)* Instead of completely eliminating oil production, this would narrow its focus into petrochemicals, introducing greater renewable energy inputs into the process, while phasing out oil from most other key sectors. *(Mastellone, 2020)*

However, to achieve these monumental changes will require two key economic preconditions. The first is a recognition of a renewed role of public sector agencies in guiding private sectors and markets into public interest activities and configurations. There is a strong case in this context for the rapid nationalisation of debilitated oil industry sectors, in order for oil producers to shield their economies as the industry winds down on a science-based timeline. This would also offer the unprecedented opportunity to protect, reskill and transition industry workers into new sustainable and renewable infrastructure projects. One of the most direct renewable sectors of easy transition for oil workers due to parallel skills and expertise would be geothermal energy. *(Aronoff, 2020a, 2020b)* Other problematic industries such as industrial agribusiness could also be transitioned on a similar basis using a nationalization model.

**Recommendation 11:** Monetary reform is required to generate debt-free financing capable of empowering governments to finance this great transition while stabilising the economy.

The remaining question of course is how such a vast programme of systemic transformation can be financed in a time of escalating global financial distress. The role of radical monetary reform can be instrumental here. Rather than borrowing money

from the private banking sector and driving up vast levels of public debt, financing can be made available debt-free by public banks (a process that was tentatively begun in the UK by the Bank of England, and although not extended in a comprehensive fashion has retained the potential to do so in a way that would free the UK economy from unsustainable debt levels). In the context of huge deflationary pressures due to the drop in work, wages and jobs, this approach avoids inflation and helps stabilise demand and production, while creating a source of sustainable financing to fund the new infrastructure investments. The more fiscal recovery and stimulus packages can be oriented toward productive investment in the core structures of new sustainable industries, the more rapid would be the ensuing transition. *(Dewhirst, 2020)*

Simultaneously, the emerging new enterprises that emerge from this confluence of processes should be structured in a way that is able to avoid the simplistic traditionally capitalist owner-worker-shareholder company structures which incentivise destructive 'endless growth' economic dynamics. New financial and social-property structures oriented around social purpose rather than exclusively for profits, along with mechanisms for more cooperative forms of incorporation and shareholdings such as employee-ownership and other such structures, can be explored. In many cases such structures have been proven to provide high performance economic dynamism within a sustainable context which supports rather than disintegrates wider ecosystems. *(Hinton, 2020)*

These sweeping financial and economic changes signal the end of neoliberalism as a viable economic model and strategy. While essential to survive the unprecedented multi-sectoral crisis ushered in by the pandemic and to mitigate the looming risks of synchronous failure, these changes fit well the potential contours of an 'ecological civilisation' that might be capable of operating safely within planetary boundaries. *(Ahmed, 2010; Baum & Handoh, 2014; Foster, 2017; Korten, 2017)*

# Conclusions & Recommendations

The COVID-19 pandemic constitutes a biophysical disruption between the Earth system and human systems representing an intensifying violation of planetary boundaries which has escalated over a period of decades since at latest the 1970s. One of the signature events of this process of civilisational decline was the 2008 financial crash, which was triggered by a confluence of energy and financial crises rooted in a fundamental geological transition into a new era of lower net energy, driving a shift to more expensive and dirtier forms of unconventional energy financed by massive debt-expansion through quantitative easing, which in turn has exacerbated fundamental structural vulnerabilities in both the global oil industry and the financial system. This in turn drove continued forms of industrial expansion which only continued to deepen the breach of planetary boundaries.

One of the 'frontlines' of this process has constituted continuing tropical deforestation. Despite long-term declines in the rate of global deforestation, the rate has remained particularly high in Southeast Asia. There has also been an uptick in the acceleration of the rate of deforestation over the last few years. This persistent trend in deforestation, representing the industrial intrusion into and destruction of natural habitats, has systematically increased the risks of human-animal interactions, and thus the risk of zoonotic disease outbreaks and, ultimately, the danger of a global pandemic. Simultaneous with the rising trend in deforestation has been increased human-animal interactions due to industrial expansion and associated practices of wildlife exploitation. Such practices eventually culminated in the 2020 COVID-19 pandemic. In this context, if current rates of deforestation continue, the risks of another potentially even worse pandemic will only increase. The 2008 crash and the 2020 pandemic thus comprise an accelerating sequence of events within a continuum of global intersystemic crisis, triggered by human systems 'overshooting' natural systems and breaching planetary boundaries in different ways.

By crashing economic demand, the COVID-19 pandemic has exposed the structural vulnerabilities in the global financial system rooted in the same biophysical processes of energetic decline. This is a system so addicted to endlessly increasing material throughput for its own sake that its suspension due to the pandemic has wrought

massive instability across multiple, interconnected sub-systems. In order to mitigate these instabilities, a reversion to business-as-usual 'normality' cannot work – it can only structurally reinforce the same systems which have breached planetary boundaries and triggered the pandemic. The pandemic has thus opened up not merely the opportunity but the paramount necessity of global intersystemic transformation through an integrated process of energetic, agroecological, financial, and manufacturing transition, facilitated by an associated paradigm shift in governance inspired by a complete reassessment of how prevailing human systems brought civilization to the current inflection point.

Transformative approaches on the 'frontline' of the crisis – deforestation – should be premised on a careful analysis of the available data, rather than a doubling down on previous failed policy approaches. The data suggests, for instance, that the preoccupation with palm oil as opposed to other commodities such as beef and soy is not merely deeply hypocritical, but also fundamentally dangerous given that beef production is the largest driver of deforestation-linked CO2 emissions (particularly so when combined with soy, which is also used as animal feed for beef production).

This has resulted in a shift, especially within Europe, toward alternative biofuels to those produced via palm oil ostensibly on the grounds that these fuels are cleaner, although the evidence indicates that they are still problematic from a climate perspective. Simultaneously, the prevailing policy approach in the form of the EU's paradigmatic de facto boycott of palm oil for biofuels has received systematic scientific critique demonstrating that the approach is likely to escalate deforestation by switching demand to other commodities such soy, rapeseed, sunflower and beyond – which use far more land, fertiliser, pesticides and water than palm oil.

This calls for a renewed approach designed to recalibrate global markets to focus on the production of ecological goods and services rather than profit-maximisation. This suggests that a more powerful framework for ending deforestation will consist of new institutional mechanisms of transnational cooperation designed to strengthen successful national efforts while generating a more targeted approach toward penalising intransigent producers.

A hub and spokes model has been suggested as a potential way to integrate nationally-mandated locally enforceable certification initiatives established in the context of

transnational partnerships between national governments and external partners such as the EU, UN or other agencies, bodies, nations or groups of nations. The recently instantiated Malaysia Sustainable Palm Oil (MSPO) standard, the world's first national legally-enforceable certification standard on sustainable palm oil, represents a compelling example of a 'spoke' in such a model, and could provide an avenue to trial this approach, considering that it already appears to have had significant success in dramatically slowing the rate of national deforestation consecutively over the last three years. This standard should be further strengthened through international scientific support as well as financial support at the 'hub' level from external partners like the EU, including for smallholder farmers, thus providing a new platform for international cooperation between a producing country and Western national governments. This model, in turn, could further be scaled up to tackle deforestation in other areas of Southeast Asia, Africa and South America.

However, tackling the 'frontline' of deforestation is only the beginning – the deeper task involves challenging the symptoms of much deeper drivers. To truly solve the crisis of deforestation and other related crises related to the systematic breaches of planetary boundaries requires transforming the fundamental structures of core industrial processes, in particular to spearhead a transition away from fossil fuels along with a shift away from 'endless growth' economics.

The failure to pursue this systemic transformation would lead to the continued escalation of the processes leading to another episode of Earth system disruption (ESD) – this could occur in the form of another disease outbreak or pandemic, a climate disaster, an energy crisis, a financial breakdown, an outbreak of civil unrest, geopolitical tensions, political collapse, or any other sub-systemic failure. Any such failure could in turn trigger a wider global level process of synchronous failure in human systems that would pave the way for further ESD leading to continued human system destabilization (HSD).

The pandemic is not only an integral symptom of an ongoing process of global systemic decline rooted in the current structure of industrial civilisation; it is an accelerant of that decline process. Yet it is also a potential opportunity to reframe and restructure the system from which this decline process has emerged. The envisaged end-result of such a reframing and restructuring is a truly 'ecological civilisation' which enables new sustainable forms of human flourishing within planetary boundaries. This is a form of social organisation which enables the conditions of life to thrive, rather than debilitates and degrades those conditions.

## Key Policy Recommendations

1. A holistic whole-systems approach is necessary to address the drivers of pandemic risk, including deforestation, by recognising their systemic interconnections.
2. Economic policy must shift away from market supremacism to the recognition of a need for intelligent management of markets by political stakeholders: a 'life-boat economy'
3. Unprecedented investments in the establishing of a new global renewable energy system are necessary to develop a new sustainable underpinning for global economic activity, but this will not be commensurate with sustaining the old model of 'endless growth'.
4. The only viable way to tackle deforestation is by transforming production practices across all relevant commodities, rather than singling out any one in particular.
5. Incentivisation structures, rather than commodity boycotts, are required to accelerate the most effective forest protection approaches. Boycotts alone can escalate deforestation.
6. Voluntary sustainability programmes are inadequate. Enforceable, mandatory legislation within producer countries is necessary to help criminalise practices that lead to deforestation.
7. Inclusive and cooperative partnerships between producer and consumer countries are critical to ensure that successful local approaches are rapidly supported and scaled.
8. The world requires a new cooperative global pact against deforestation that can empower developing nations rather than alienate them.
9. Trade deals should be re-oriented towards recalibrating markets so that they work in the public interest to protect the ecological foundations of markets.
10. Structural transformation is required within developed, consumer countries to create a new clean industrial paradigm that reduces the drivers of unsustainable consumption-led growth. New stimulus packages are required to kick-start productive investments in this new paradigm.
11. Monetary reform is required to generate debt-free financing capable of empowering governments to finance this great transition while stabilising the economy.

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