

- 1 Growing Evidence of the Interconnections between Modern Slavery, Environmental
- 2 Degradation, and Climate Change
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5 **Summary**

6 The modern slavery – environmental degradation – climate change nexus may threaten the
7 achievement of the Sustainable Development Goals (SDGs). Globally, approximately 12.2
8 million workers are entrapped in modern slavery in environmentally degrading activities, and
9 SDG target 8.7 (the elimination of all forms of modern slavery) may be instrumental in
10 accelerating attainment of SDG targets. However, without appropriate mitigation strategies,
11 the attainment of some of the SDG’s environmental targets may also negatively influence
12 progress on 8.7. Unfortunately, these feedbacks are poorly understood and data are limited
13 and difficult to obtain. In this perspective we presented how a SDG interaction framework
14 may help overcome these data challenges by signalling how potential policy action and other
15 interventions would influence progress on 8.7 and other environmental targets based on
16 known processes and patterns. This understanding is crucial to move beyond data limitations,
17 direct future research, and develop an often lacking evidence-base to effect holistic change.

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27 **Introduction**

28 Sustainable Development Goal (SDG) target 8.7, “take immediate and effective
29 measures to eradicate forced labour, end modern slavery and human trafficking and secure
30 the prohibition and elimination of the worst forms of child labour...”¹ was a last-minute
31 addition to the post-2015 international sustainable development agenda after being excluded
32 from the preceding Millennium Development Goals (MDGs).² This marked a critical juncture
33 in the evolution of the conceptualization of modern slavery. Modern slavery had been linked
34 to the socioeconomic imperatives included in the MDGs and SDGs,³⁻⁴ but the underlying
35 indivisibility principle of the SDGs provided a blueprint to galvanize exploration into the
36 interconnections between modern slavery, environmental sustainability, and climate.
37 However, the measurement challenges underpinning the dearth of baseline modern slavery
38 data have made identifying and understanding salient features of an emerging modern slavery
39 – environment – climate nexus difficult. For example, there are no indicators for forced
40 labour, modern slavery, and the worst forms of child labour associated with target 8.7. The
41 unlawfulness, danger, and hidden nature of these activities complicates and sometimes
42 prohibits data collection. Further, a lack of global understanding of differing typologies and
43 standardized definitions and measurement tools inhibits disaggregated comparative analyses
44 across sectors, scales, and geographies.⁵ As a result, an incomplete picture of modern
45 slavery’s interactions with the environment and climate persists, potentially delaying policy
46 and action and subverting progress toward attainment of the SDGs.

47 In this perspective we explored how linkages facilitating a modern slavery-
48 environmental degradation–climate change nexus may influence achievement of the
49 SDGs. Using an adapted SDG interaction framework to synthesize expert judgement, we
50 assessed the strength of interactions between SDG 8.7 and targets from SDGs 6, 7, 9,
51 11, 12, 13, 14, and 15. This approach elucidated pertinent research gaps hindering

52 understanding of this nexus and thus the maximization and minimization of the identified
53 synergies and trade-offs between SDG targets.

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55 **The Modern Slavery - Environment - Climate Nexus**

56 There is no generally agreed international legal definition of modern slavery;
57 therefore, for the purpose of this paper we are using the Research Network on the Legal
58 Parameters of Slavery’s 2012 Bellagio-Harvard guidelines wherein modern slavery is defined
59 as “constituting control over a person in such a way as to significantly deprive that person of
60 [their] individual liberty, with the intent of exploitation through the use, management,
61 purchase, sale, profit, transfer or disposal of that person”.⁶ In this way, we are also using
62 modern slavery as an umbrella term that encompasses egregious forms of labour exploitation
63 that do not always constitute slavery but that are codified in international law and policy such
64 as forced labour,⁷ human trafficking,⁸ and the worst forms of child labour.⁹ The use of
65 modern slavery is consistent with emerging national legislation (i.e., UK and Australia
66 Modern Slavery Acts) and international priorities (i.e., UN SDG 8.7). However, we also
67 recognise the lack of a generally agreed definition of modern slavery as well as the
68 continuing discussions regarding the diversity of elements and influence of various bodies
69 included in different definitions, noting that some definitions are contradictory. The Bellagio-
70 Harvard guidelines were selected because of their origins in a consensus-making process
71 involving scholars and practitioners, and their emphasis on the deprivation of human dignity
72 and agency in understanding contemporary forms of slavery. We also recognise that the
73 identification of the worst forms of child labour in extractive industries requires complex and
74 nuanced consideration, as international codes and agreements can be imbued by western
75 perspectives on the participation and roles of children in the household, workforce, and
76 society at large.¹⁰ There are non-labour typologies of modern slavery and other pertinent

77 exploitative labour practices, including violations of labour rights, interconnected with
78 environmental degradation that do not fall under the umbrella of modern slavery and are
79 beyond the scope of this paper.

80 Labour typologies of modern slavery co-occur in many of the same geographies
81 disproportionately incurring the effects of climate change and experiencing ecological
82 conflict and environmental change, including degradation and environmental crimes.^{11,12} For
83 example, NGOs and scholars have identified hotspots for the use of exploited labourers in
84 the Brazilian Amazon¹³ where illegal deforestation is increasing¹⁴; in remote areas of Latin
85 America where illegal mining (sometimes state sanctioned) flourishes in conflict zones¹⁵; in
86 the Democratic Republic of the Congo where mining results in the release of environmental
87 toxins and deforestation, and industrial scale poaching threatens biodiversity^{13,16}; in Thailand
88 where fish stocks are depleted¹⁷; and across South Asia where brick kilns are a major
89 contributor to air pollution and black carbon emissions.¹⁸ In these hotspots environmental
90 and/or human rights governance is weak or undermined by corruption, structural
91 socioeconomic inequalities and power imbalances are frequently exploited, access to
92 resources is inequitable, indigenous rights are ignored, livelihood opportunities are limited
93 and vulnerable to shocks, and conflict abounds. However, these hotspots do not imply that
94 these co-occurrences are isolated issues. The globalization of supply chains and global
95 movement of poor, low-wage migrant workers—who are the most vulnerable to modern
96 slavery—make this a global phenomenon.

97 Emerging evidence has also shifted scholarly understanding beyond mere co-
98 occurrences, identifying recurrent and non-linear bi- and multi-directional patterns of
99 interactions between modern slavery, environmental degradation, and climate change—
100 signalling a nexus. This nexus is posited to occur in fishing, brick making, mining/quarrying,
101 manufacturing (e.g., fast fashion), forestry (e.g., logging), agriculture, renewable energies,

102 and the trafficking of wildlife.^{13,18} Activities associated with modern slavery in these sectors
103 share certain commonalities: the presence of informal markets and operations; low wage and
104 seasonal work; high manual labour intensity; inherently dangerous working conditions;
105 operation in remote and isolated environments removed from monitoring and enforcement; a
106 scarcity of labour that engenders a reliance on vulnerable migrant workers; and diffuse illegal
107 extraction of natural resources that increasingly attracts transnational criminal organizations
108 as natural resources become more scarce.^{13,19,20}

109 There are also three overarching patterns noted in this nexus. First, labourers
110 subjected to modern slavery, are forced to participate in environmental criminal activities.¹³
111 These environmental crimes are financially lucrative with a low risk of detection when
112 perpetrating actors evade control and enforcement by subjecting workers to conditions of
113 modern slavery.²¹ For example, it is estimated that some 40% of deforestation is
114 accomplished with workers subjected to modern slavery.¹³ In this manner, environmental
115 degradation is an outcome of modern slavery. The proportion of total CO₂ emissions
116 generated through deforestation is variously estimated between 17% and 30%.²² This means
117 that people caught up in forms of modern slavery that are environmentally destructive are
118 also generating CO₂ emissions contributing to climate change.

119 Second, environmental degradation and unsustainable extraction *pulls* vulnerable
120 workers into conditions of modern slavery by creating a demand for cheap labour in these
121 sectors.^{13,23} When resources become more scarce, many of these industries could not continue
122 in their primitive and inefficient production without modern slavery, thus modern slavery can
123 function like a subsidy allowing activities to remain profitable.²⁴ And in many geographies,
124 the acquisition of forced labour is cheaper than upgrading to new and more efficient
125 technologies.²⁵ Additionally, extractive industries use modern slavery to retain a competitive
126 advantage in conflicts over natural resources.²⁶

127 The third discernible pattern is when environmental degradation and/or climate
128 change drive modern slavery. While poverty is widely characterised as the predominant
129 predictor of modern slavery,³ a linear conception of poverty causing modern slavery is an
130 oversimplification. Poverty is multidimensional. The degradation, scarcity, and lack of access
131 to natural resources are key dimensions of poverty that are also intertwined with the
132 inequitable political, social, and cultural vulnerabilities to modern slavery such as poor
133 governance, corruption, and systemic discrimination.^{3,13} Further, climate change has a
134 multiplier effect, exacerbating pre-existing disparities and conditions and introducing greater
135 volatility in the income and livelihood shocks associated with environmental degradation,
136 *pushing* people toward modern slavery by compelling them to migrate for work or improved
137 living conditions, enter opaque and precarious situations, and/or accept below standard
138 working conditions – all increasing their vulnerability to modern slavery.^{27,28}

139 However, the processes that facilitate these key patterns and how they map onto
140 dimensions of sustainability and SDG environmental imperatives are less understood and
141 have not been systematically interrogated despite the growing body of evidence of a modern
142 slavery–environmental degradation–climate change nexus^{11,13,16,18,29-31} and increasing
143 attempts at elucidating the interactions that underpin the indivisibility principle of the
144 SDGs.³²⁻³⁸ SDG 8.7 remains distinct and often poorly integrated with the SDGs’
145 environmental imperatives in solution development and implementation and policy action.
146 One possible reason for this is that ending modern slavery is placed within an overarching
147 goal of economic growth–seen by some to be in conflict with environmental objectives.³⁹
148 Singh et al., for example, discussed the trade-offs between SDGs 14 and 8 pointing out that
149 ending overfishing and harmful subsidies (goal 14) would constrain the achievement of
150 economic growth (goal 8)³⁶; despite evidence that ending overfishing could also reduce

151 modern slavery in fishing.³⁰ This demonstrates the need to explore and assess relationships
152 between targets instead of goals.

153 While broad patterns between modern slavery and the environment and climate have
154 been ascertained, it is difficult to quantify the strength of specific relationships and
155 interactions at the target level due to a global absence of modern slavery data generated
156 through primary collection. Instead, in-depth (and often isolated) NGO or media case reports
157 are used to understand the characteristics of the phenomenon, and socioeconomic and socio-
158 political risk proxies are used to extrapolate the scale of the problem.¹⁶ Consequently, it is
159 still unknown if shifting prevalence estimates are a product of fluctuating prevalence or
160 changes (including) improvements in measurement; it is unclear how often risk becomes
161 occurrence; there is an absence of longitudinal data to identify trends and patterns; untested
162 hypotheses may become accepted without adequate interrogation; and it is difficult to
163 synthesize modern slavery data with other data sets to analyse the influence of mediating and
164 moderating variables on causal pathways and to identify novel confounders and covariates.
165 Risk proxies, used to circumvent data challenges, should be selected on evidence-based
166 connections;⁴⁰ yet, a threshold of data is also needed to even signal new connections for
167 further exploration and evidence development. These interdependent data challenges can thus
168 result in reductionist thinking that can be difficult to disrupt. For example, it took a large-
169 scale and geographically widespread campaign⁴¹ to generate widespread, transdisciplinary
170 interest in the link between fish stock declines and modern slavery in marine fisheries despite
171 years of evidence.^{21, 42-44} But now there are concerns that scholarly research has again become
172 too narrowly focused, fixated on modern slavery and environment connections in fishing at
173 the risk of disregarding the same interconnections in terrestrial ecosystems.⁴⁵

174 Modern slavery represents one of the most egregious human rights violations and
175 there is an urgent need to work towards eliminating all forms. However, nexuses are rife with

176 complex interactions and dynamic feedbacks. Without data to better elucidate the dimensions
177 of this modern slavery–environment–climate nexus, there is a risk of jumping to
178 oversimplified solutions that are inadequate, or worse, looking past these feedbacks that
179 could result in deleterious unintended consequences.⁴⁶ The challenge of a lack of data to
180 specify and quantify the dimensions of this nexus remains, but with less than 10 years until
181 the SDG deadline to end conditions of modern slavery for an estimated 12.2 million workers
182 (more than 3,300 per day) in environmental activities,⁴⁷ many that are illegal or highly
183 degrading, solutions cannot wait for exhaustive research and require an evidence-based
184 springboard that can be built on, iterated, and refined over time as more robust data
185 materializes.

186 **Expert Judgement of Potential SDG Interactions**

187 To catalyse the development of such a springboard, we used a two-step literature
188 search and expert judgement process.^{48,49} First, we selected the most relevant
189 environmentally-oriented SDG targets based on our collective expertise in researching
190 modern slavery (see Table 1).⁵⁰ We then conducted a literature search using target 8.7's key
191 terms (i.e., forced labour, modern slavery, human trafficking, and the worst forms of child
192 labour) as an entry point in conjunction with sustainability dimensions (i.e., key and
193 analogous terms for the other 20 pre-selected targets)⁴⁸ (Table S1). Academic (e.g., Web of
194 Science) and news databases (e.g., Factiva) were searched in addition to completing general
195 web searches. After the initial searching, we also obtained records through reference chaining
196 and by contacting frontline NGOs for previously unpublished reports. We collated a
197 comprehensive collection of approximately 700 empirical papers and other academic works
198 (e.g. scholarly books); dissertations and theses; United Nations, government, non-
199 governmental organisation (NGO), civil society, and private sector reports; and investigative
200 journalism and popular media reports on NGO findings and activities otherwise not

201 externally released. Based on our experiences and partnerships we were aware that many
202 front-line NGOs do not publicly release more detailed reports on their findings but that media
203 reports were likely to capture this information, hence their inclusion. The breadth of records
204 was also intended to elucidate a more holistic and in-depth understanding by including a
205 range of disciplinary and front-line expertise beyond the paucity of available empirical
206 literature.¹¹ While modern slavery and environmental degradation occur at all stages of a
207 supply chain, the literature search focused only on the extraction/production nodes.

208 After eliminating duplicate records and records that just detailed a co-occurrence (i.e.,
209 described them as discrete events or phenomena without exploring the possibility of a
210 connection), we assessed 176 records (Table S2) by applying a seven-point framework (Table
211 2).^{32,33,35} This framework has previously been used to provide an initial semi-quantitative
212 assessment of specific SDG target interventions' influence on other SDGs, based on the
213 indivisibility principle of the SDGs. Since most of our limited extant data from the records
214 focused on qualitatively describing the relationship between modern slavery and the
215 environmental or climatic phenomenon, we did not fully apply the framework but rather
216 adapted it to describe and identify where there is the possibility for a policy/intervention
217 interaction that would need to be considered when designing future solutions to achieve the
218 SDGs based on how the phenomena appear to be connected. Specifically, the framework
219 aided in the development of a novel data extraction tool used by all four coders (Note S1),
220 guiding the accumulation of knowledge about context-dependencies (e.g., time, geography,
221 contextual and confounding factors) and facilitating a process wherein the research team's
222 expertise was elicited to shape and expound on information from the records by using expert
223 judgement^{48,49} to score the strength and direction of potential intervention interconnections
224 (Table 2).^{32,35} Each record was scored for interactions by at least two experts using the
225 following reflexive question: "Based on the processes described in the record that connect the

226 phenomena, and our expertise, if progress is made on target X, what may happen to progress
227 on target Y?”⁵¹ (see Note S1 for coding guidance). Disagreements in scoring, which
228 accounted for approximately 16% of records, were discussed amongst the team until
229 consensus was reached. Knowledge accumulation, synthesis, and interpretation explored the
230 patterns of relationships, processes, interactions and feedbacks that may facilitate a modern
231 slavery – environment – climate nexus and identified the lock-ins and human and non-human
232 emergent and structural drivers of modern slavery, direct and indirect.

233 Though Nilsson et al.’s³² framework has been critiqued for the limited utility of its
234 semi-quantitative analyses (e.g., practical significance of each value is unclear particularly in
235 settings with multiple interactions that may be influenced by one intervention),⁵² we saw it as
236 a starting point since the current dearth of data limited more sophisticated modelling.
237 Selection of the framework was based on the tool’s ability to signal where we needed better
238 research and more informed policy and intervention steps. The mutual exclusion of the
239 SDG’s economic and social targets, and the use of two-way interactions likely oversimplified
240 the nexus, but the social and economic interactions with 8.7 are well documented throughout
241 the literature. The use of subjective expert judgement also decreased the validity of the
242 assessment³³, but was necessary in the absence of more conclusive data. Despite these
243 limitations, the limited application of the framework aided in organising and synthesizing
244 existing knowledge about 8.7’s potential interactions with environmental targets during
245 interventions and policy action. And it identified gaps in knowledge for researchers³² and
246 potential priority areas for decision makers where integrated or synergistic decision making
247 across sectors is necessary.³³ While this assessment represented a first-step in unpacking the
248 complexity of the multiple dimensions of the modern slavery – environment – climate nexus,
249 the use of the framework identified priority research pathways for continued advancement.

250 Amongst the 176 records assessed, environmental degradation associated with
251 specific sectors was discussed including agriculture ($n=65$), mining/quarrying ($n=53$),
252 renewable energy ($n=40$), forestry ($n=33$), fishing ($n=33$), brickmaking ($n=15$), wildlife trade
253 ($n=10$), and manufacturing ($n=8$). An additional 60 records highlighted unspecified
254 environmental degradation ($n=5$), and environmental change associated with natural hazards
255 ($n=14$) and climate change ($n=41$). Some records presented evidence across multiple sectors.
256 A total of 551 interactions were identified in the assessment, mostly scored as synergistic
257 with the notable exception of SDG goal 7 (affordable and clean energy) targets (Fig. 1).
258 Scores ranged from -2 to +2, with +1 the most allocated score. This was expected as not all
259 modern slavery is linked to environmental degradation and climate change, and not all
260 environmental degradation is caused by modern slavery. However, some records did discuss
261 the potential of environmental degradation and climate change potentially being characterized
262 as a root cause (a +3 indivisible score) of modern slavery as more data becomes available and
263 the nexus is better understood.⁵³ While there were pronounced geographic hotspots (e.g.
264 Brazil, the Democratic Republic of the Congo, and India), most countries had at least one
265 interaction noted in the literature (Fig. 2), and a low number or no located interactions did not
266 necessarily absolve a country from some occurrence of the nexus and instead may suggest
267 geographic areas for future research. Some records did not specify a geography, instead
268 focusing on international or regional patterns. There was also exponential growth in the
269 number of records published over time, with just two records published before 2000 and an
270 additional 11 published between 2000 and 2010. However, more than half of the records ($n =$
271 101) were published in the last three years (2017 or later). Approximately 75% of the records
272 ($n=130$) were from academic or NGO/CSO sources with the strength of evidence primarily
273 characterised as exploratory ($n=74$) or descriptive ($n=82$) as data was most likely to be

274 collected through desk-based research, qualitative interviews with stakeholders, and/or small
275 convenience samples of qualitative interviews and surveys with workers.

276 *SDG 6: Clean Water and Sanitation*

277 Interactions identified between 8.7 and SDG 6's targets were primarily categorized as
278 enabling, in that the achievement of one target would indirectly aid the achievement of the
279 other (Table S3). The main narratives detailed legal and illegal (though many illegal mining
280 operations are informal, unorganised networks of impoverished community members versus
281 criminal networks) mining activity operating side-by-side. While modern slavery and the
282 worst forms of child labour occurred in both, the legal and informal operations were
283 providing a guise for the more illicit operations which were more likely to subject workers
284 modern slavery to hide their environmental crimes including the dumping of hazardous
285 wastes into water sources (targets 6.3 and 6.4). In addition, target 6.1's focus on safe drinking
286 water for all is intrinsically linked with modern slavery as lack of potable water for drinking,
287 cooking, and bathing is an indicator of indecent living conditions for workers and safe
288 drinking water was identified as an indirect push factor into modern slavery when
289 unrealised.⁵⁴ Specifically there were accounts of women's risk for human trafficking for sex
290 and labour increasing as they had to walk further to obtain clean water, meanwhile
291 simultaneously there was an influx of migrant workers from industrial mining operations that
292 created an increased demand.⁵⁵

293 *SDG 13: Climate Action*

294 Positive interactions between SDG 13's targets (13.1, 13.2, and 13.3 about climate
295 resilience, climate policies, and climate education respectively) and 8.7 (Table S4) almost
296 ubiquitously described situations where either acute (e.g., typhoons) or slow onset (e.g.,
297 drought) hazards pushed vulnerable people into modern slavery because they were either

298 displaced (and traffickers recruited in camps or settlements) or forced to migrate out of
299 desperation to meet basic needs that were no longer being met by their natural resource-based
300 livelihoods, seeing migration as the only viable option.^{28,56,57} Many households also perceived
301 migration as an opportunity to diversify income sources, with just one or two household
302 members (including children) migrating to look for work in other areas.⁵⁸ The evidence was
303 inconclusive about the role of climate change and natural hazards. The majority of records
304 specific to target 13.1 ($n=28$ records) described climate change and natural hazards as
305 exacerbating and intensifying pre-existing vulnerabilities stemming from socioeconomic and
306 environmental inequities, factors that also inhibited adaptive capacities. Thus mitigating the
307 effects of climate change could enable the elimination of (some forms) of modern slavery.
308 However, other records ($n=15$) were coded as reinforcing, in that the relationship between
309 modern slavery and climate change was now described as a direct relationship, with modern
310 slavery characterised as a mal-adaptive strategy to climate change. Records coded as
311 reinforcing were more likely to be published post-2016, suggesting a potential shift in our
312 understanding of this relationship with improved research and data.

313 *SDG 11: Sustainable Cities and Communities*

314 Interactions between SDG 11's targets and 8.7 were conspicuously absent from the
315 literature considering that most climate change/environmentally induced migration is
316 expected to be from rural to urban areas.^{28,59} Only five positive interactions were identified:
317 two reinforcing and one enabling interaction with target 11.5 (reduce the number of
318 vulnerable people affected by disasters) and two reinforcing interactions with 11.B regarding
319 holistic disaster risk management. The main narratives concerned the need for mainstreaming
320 anti-slavery tools into resilience building and disaster frameworks considering traffickers are
321 likely to recruit vulnerable climate migrants from their destination – urban slums. This is a
322 critical area for further exploration because of emergent considerations about social

323 exclusivity in sustainable development and resilience building activities exacerbating the
324 vulnerability of the most marginalised populations.^{60,61} Workers subjected to modern slavery
325 have long been considered an invisible population, and the global trend toward more
326 restrictive and hostile immigration policies only further oppresses them as many fear
327 immigration repercussions if they come forward or seek assistance. Therefore sustainable
328 development must grapple with how to deliberately include an invisible population in
329 development approaches.

330 *SDG 9: Industry, Innovation and Infrastructure*

331 Despite salient connections between targets 8.7 and 9.4 – in part, 9.4 upgrading
332 infrastructure and retrofitting industries aims to reduce the very activities most likely to
333 subject workers to modern slavery – only five interactions were noted in the literature: two
334 negative and three positive (Table S5). Specific to 9.4’s connection to 8.7, these are often
335 polluting activities highly reliant on intense, manual labour (e.g., brick kilns and certain
336 forms of manufacturing)¹⁸ wherein subjecting workers to modern slavery is “cheaper” than
337 upgrading to new technologies.¹³ And while modern technologies can make these activities
338 more efficient and environmentally sound and reduce the need for subjecting workers to
339 modern slavery, mechanisation also eliminates jobs and displaces the same low-wage
340 workers making them potentially more vulnerable to modern slavery in other sectors. This
341 gap in the literature is significant because it remains unclear where on the spectrum from full
342 manual labour to full mechanisation the optimal combination of new technologies and
343 manual labour lies. For example, one of the negative interactions noted in the records was the
344 use of some mechanisation in production to optimize deforestation and obscure modern
345 slavery by deceiving satellites that monitor changes in environmental conditions as a proxy
346 for both.⁶²

347

348 *SDG 7: Affordable and Clean Energy*

349 SDG 7 was the only goal with targets that overall negatively interacted with 8.7
350 (Table S6). Clean and renewable energies are touted as necessary to reduce CO₂ emissions
351 and mitigate global warming; yet, progress on increasing renewable energy (target 7.2) is
352 likely to counteract progress toward eliminating modern slavery due to the surge in demand
353 for cobalt in renewable energy storage. Cobalt is mined in limited geographies, with the
354 Democratic Republic of the Congo the world's largest supplier producing an estimated 60-
355 70% of all cobalt.⁶³ The DRC is also one of the most impoverished countries in the world
356 with poor governance, ongoing conflict, and is also estimated to have the 12th highest
357 prevalence of modern slavery in the world.⁶⁴ Here the worst forms of child labour occur in
358 both legal and illegal industrial and artisanal mines alongside debt bondage and forced labour
359 as families facing abject poverty cannot afford to pay for their children's education and few
360 other livelihood opportunities exist. To date, it is difficult to ensure "clean" cobalt from the
361 DRC, though this negative interaction could be potentially mitigated or even reversed with
362 appropriate and innovative action from both governments and the private sector.⁶³

363 However, in parts of Asia, enabling synergies between targets 7.1, 7.2 and 8.7 were
364 identified. In some countries, energy poverty indirectly leads to increased risk for human
365 trafficking as a lack of access to modern energy increases poverty, economic vulnerabilities,
366 and social exclusion (particularly of women) while simultaneously decreasing education, all
367 known predictors of human trafficking risk.⁶⁵ Thus, small-scale targeted interventions are
368 currently empirically exploring if greater access to energy can create conditions that enable
369 the elimination of modern slavery.

370 *SDG 12: Responsible Consumption and Production*

371 The implications of responsible consumption are manifold. The plethora of
372 inexpensive and disposable consumer goods hides the true environmental and social costs of
373 production as noted. Yet, a paradigm for a truly just transition has yet to be expounded and
374 criticisms of some facets of sustainable consumption being privileged remain.⁶⁶ However, the
375 efficient use of natural resources (target 12.2) and the environmentally sound management of
376 chemicals and wastes (target 12.4) are likely to have more immediate benefits for the
377 vulnerable populations that disproportionately bear the burden of destruction from natural
378 resource extraction and waste disposal, reducing their risk of modern slavery (though the
379 evidence was inconclusive whether this relationship was enabling or reinforcing) (see Table
380 S7).

381 While less about the interconnections creating the nexus, target 12.6 – integrating
382 sustainability information into the reporting cycles of large and transnational companies – is
383 germane to the solutions. However, the integration of labour rights and modern slavery into
384 reporting and subsequently even certification schemes has faced challenges with connectivity
385 being an afterthought. Environmental and modern slavery directives are still
386 compartmentalised in pre-reporting and reporting activities, and interconnections are only
387 brought together, if they are brought together at all, in the report itself. This often leads to the
388 prioritisation of one issue over the other, typically the environmental conditions, and more
389 opaque monitoring and evaluation strategies that lead to empty transparency statements and
390 reporting. And while the UN Global Compact has helped galvanise voluntary and regulated
391 action, there have been reports of integrated sustainability reporting backfiring with concerns
392 that environmental certification cover-up modern slavery in globalised supply chains.⁶⁷⁻⁶⁹

393 *SDG 14: Life Below Water*

394 All interactions identified between 8.7 and SDG 14's targets were positive (Table S8).
395 Most records described a chain reaction wherein poor capture fisheries management led to
396 overfishing, resulting in decreased catch and increased effort, reducing profitability. When
397 coupled with labour shortages in the sector, this series of events increased demand for cheap
398 labour, pulling impoverished migrant workers into precarious work and indebtedness.
399 Because migrant fishers are often from lower-income countries in comparison to the vessel's
400 owner and/or captain, discrimination rationalises the abuse of fishers. Subjecting workers to
401 modern slavery also functions as a subsidy, propping up enterprises that would otherwise be
402 unprofitable. In this way, modern slavery then also enabled overfishing (SDG target 14.4).
403 Modern slavery was also more likely to be identified on vessels fishing illegally (14.4) and
404 distant water fleets receiving government subsidies for fuel (14.6).^{17,30,42,70}

405 Interactions were also not limited to marine capture fishing. Reports of shrimp fry
406 collection and shrimp farming noted enabling interlinkages between environmental
407 degradation and modern slavery. The use of child labour to illegally catch shrimp fry was the
408 most documented typology of modern slavery in the harvesting of wild shrimp (SDG target
409 14.4). On the other hand, unsustainable shrimp farming and its associated environmental
410 degradation of coastal ecosystems (SDG target 14.2) displaced the landless poor
411 (predominantly women) forcing them into extreme indebtedness to work in same sector,
412 perpetuating the environmental degradation that displaced them.³¹

413 *SDG 15: Life on Land*

414 The majority of positive interactions depicted a convergence of SDG 15's targets
415 creating interrelated push and pull factors for vulnerable populations, though the strength of
416 the interaction was dependent on geography (Table S9). Subjecting workers to modern
417 slavery was a strategy for hiding environmental crimes associated with illegal mining,

418 logging, and deforestation while maximising profits, thus creating demand for cheap labour
419 (target 15.2).^{57,71} Meanwhile, targets 15.1 (conservation of freshwater ecosystems and their
420 forests), 15.3 (combat desertification), and 15.5 (halt biodiversity loss) were all associated
421 with environmental factors that, when unmitigated, erode financial and natural capital and
422 create a vulnerable supply of desperate workers, pushing individuals and households
423 (including children) into modern slavery. The ensuing degradation associated with the forced
424 criminal exploitation of these workers subjected to modern slavery then pushes others, while
425 not into modern slavery, into informal operations that are unregulated, hazardous, and highly
426 degrading themselves (15.2).

427 **Developing Research Pathways Forward**

428 The limited application of this framework highlighted four key areas for future
429 research: 1) quantifying unique contributions, 2) defining temporality, 3) establishing
430 frameworks to recognise and balance varied knowledge and data sources, and 4) determining
431 the importance and sequence of push and pull determinants. Specific to quantifying the
432 unique contributions, not a single record reviewed quantified the unique contributions of 8.7
433 to other targets or vice versa. Thus there remains the need to determine the true extent that
434 modern slavery contributes to environmental degradation and climate change, as well as the
435 reverse, how much environmental degradation and climate change contribute to modern
436 slavery. The breadth of targets interlinked with 8.7 in this analysis justifies the need to
437 undertake this research to ensure appropriate and holistic allocation of resources in achieving
438 the SDGs. Second, less than a third of interactions in the assessment could be coded for even
439 rudimentary, binary temporality (i.e., proximal or distal relationship between modern slavery
440 and environmental degradation/climate change) due to a lack of longitudinal data and
441 temporal variables. Besides being a foundational component of more rigorous research, time
442 and temporality is also relevant to understanding where and when to introduce interventions

443 and for monitoring and evaluating the efficacy of interventions including policy action. A
444 better understanding of time and temporality will also diminish the potential for failed
445 interventions that result from implementing solutions before fully understanding confounding
446 processes. Thirdly, the beginning transdisciplinary exploration of the nexus has increased
447 opportunities for integrating novel and innovative data sources into modern slavery research
448 like Earth Observation (EO) data, mobile data call records, and big data.^{18,30,72,73} However,
449 the inclusion of these new tools cannot be at the exclusion of worker narratives. Likewise, the
450 associated data and knowledge forms of a number of disciplines are necessary to deliver
451 answers to these research questions. Without this balance, there is again the risk of
452 implementing oversimplified solutions. Lastly, understanding which push and pull factors are
453 the most important, and their sequencing, will help elucidate leverage points to design more
454 efficacious interventions and policy action.

455 Five main themes regarding potential action steps also emerged from the limited
456 application of the framework. First, specific to policy action, modern slavery and
457 environmental conservation, management, and sustainability suffer from the same barriers:
458 lack of or weak implementation and reinforcement of key instruments available, lack of
459 regional cooperation to prevent backsliding and spatial displacement, lack of political will
460 power, and corruption and thus can draw from the same tools. In fact, there is a growing body
461 of literature about how the environmental movement could capitalise on lessons learned from
462 similar successes and failures of the abolition movement of the 18th and 19th century.^{74,75}
463 Second, private sector engagement needs to have an expanded and more holistic, cross-
464 sectoral mandate. For example, deforestation initiatives may focus exclusively on the forestry
465 sector, ignoring the deforestation caused by agricultural or illegal mining.⁷⁶ While this cross-
466 sectoral approach needs to be reinforced in policy action, private sector initiatives can
467 provide replicable and scalable templates. Third, the same technology that is powering

468 innovation in research domains, can be applied to improve on-the-ground conditions. For
469 example, the UN Development Programme is using EO data and machine learning techniques
470 developed by scholars to map kilns across South Asia’s Brick Belt in order to facilitate
471 change in fuel and firing technologies and address severe air pollution emitted by traditional
472 brick kilns.^{18,77} And while bonded labour may still exist in the kilns, the improvement in
473 technologies is the beginning of step-wise changes to improve working conditions and better
474 define decent work in the context of a changing environment. Next, prosecutions of gang
475 masters for modern slavery, and actors committing environmental crimes, focuses on
476 preventing individual actors from repeating their crimes and building norms within the sector.
477 However, prosecutions do not repair the suffering that has already been inflicted on the
478 environment or workers. This suggests a need for a novel social-ecological restorative justice
479 paradigm in addressing for the nexus. And lastly, just as there is a need to centre worker
480 narratives in research, there is also a critical need and role for worker-led innovation in
481 designing solutions, as modern slavery survivors have made clear: “nothing about us without
482 us”.⁷⁸

483 **Modern Slavery and Sustainable Development**

484 If contemporary forms of slavery obstruct sustainable development and contribute to
485 climate change and other environmental challenges, how would the elimination of modern
486 slavery contribute to sustainable development? The potential answer is threefold. First,
487 workers subjected to modern slavery are financing some of the illegal and destructive
488 practices that hinder sustainable development by excluding legitimate and appropriate
489 development. Eliminating modern slavery means removing some criminal drivers that exploit
490 and destroy both people and the natural world. Second, ending slave-based activities within
491 areas of high biodiversity and critical natural resources, may create the opportunity for more
492 sustainable practices to be implemented. Freed workers, for example, have found new

493 employment in sustainable forestry in the Amazon.¹³ When allowed to work for themselves
494 and their families, workers formerly subjected to modern slavery generate incomes and
495 purchase goods creating an upward economic spiral in their communities that has been come
496 to be known as a ‘freedom dividend’.^{25,79} Third, if environmentally destructive commodities
497 produced by workers subjected to modern slavery are removed from global supply chains, the
498 proceeds that once went to criminals may be more likely to flow to workers and local
499 communities – though that likelihood is not always assured given the nature of global
500 markets and governmental control of industries by some countries.⁸⁰ That said, regulating and
501 requiring the inspection of supply chains to remove commodities and products that are
502 destructive of both the environment and human rights and wellbeing supports Sustainable
503 Development Goals across a number of areas, from children’s and women’s rights, to
504 environmental protection, to worker’s rights, to reducing conflict. Initiatives like the
505 *Transparency in Supply Chains* provisions of the United Kingdom’s Modern Slavery Act
506 (2015)⁸¹ create the foundation for such just actions.

507

508 **Conclusion**

509 Concepts of development have shifted and grown over time, with new paradigms
510 integrated to overcome identified deficiencies and inefficiencies. In 1970 Ester Boserup⁸²
511 revolutionised our understanding of development when she introduced the concept of the
512 ‘gender lens.’ Over time, as her ideas were adopted across the development community, and
513 women were moved to the centre of development planning, outcomes dramatically improved.
514 Today, gender mainstreaming is considered an accelerator for achieving the SDGs.⁸³ The
515 ‘gender lens’ was controversial in its time, and an ‘anti-slavery lens’ is seen by some
516 commentators to be controversial today.⁸⁴ But placing an otherwise invisible population in

517 juxtaposition with other social and natural forces has the same potential for improved
518 outcomes. From the modern slavery perspective, there is a need to accommodate the
519 complexity of non-traditional socioeconomic factors that contribute to modern slavery.⁸⁵ And
520 from a sustainability perspective, there is a need to better understand and integrate anti-
521 slavery tools⁸⁶ to prevent undermining environmental objectives. Applying a modern slavery
522 lens will help accelerate sustainable development and the achievement of the SDGs.

523

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528

529 **Author Contributions**

530 All authors contributed to the conceptualisation and writing. J.D.S. and B.J. collated
531 and initially reviewed the literature. All authors contributed expertise to the limited
532 application of the framework and the interpretation of findings.

533

534 **Declaration of Interests**

535 J. L. Decker Sparks is also affiliated with the Cummings School of Veterinary
536 Medicine at Tufts University and the Stanford University Center for Ocean Solutions.

537

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539 **References**

- 540 1. United Nations Sustainable Development Goals Knowledge Platform. (n.d.). Sustainable
541 Development Goal 8. <https://sustainabledevelopment.un.org/sdg8>
- 542 2. Freedom United. (n.d.). Field report: Modern slavery in UN Sustainable Development
543 Goals. [https://www.freedomunited.org/our-impact/slavery-sustainable-development-](https://www.freedomunited.org/our-impact/slavery-sustainable-development-goals-2/)
544 [goals-2/](https://www.freedomunited.org/our-impact/slavery-sustainable-development-goals-2/)
- 545 3. Bales, K. (2006). Testing a theory of modern slavery (Free the Slaves).
546 https://lastradainternational.org/Isidocs/bales_test_theory_0607.pdf
- 547 4. Crane, A. (2013). Modern slavery as a management practice: Exploring the conditions
548 and capabilities for human exploitation. *Acad Manage Rev* 38, 49-69.
- 549 5. Walk Free. The Global Slavery Index 2019: Measuring progress (Minderoo Foundation),
550 <https://www.globallslaveryindex.org/2019/findings/measuring-progress/>
- 551 6. Research Network on the Legal Parameters of Slavery (2012). The Bellagio-Harvard
552 Guidelines on the Legal Parameters of Slavery.
553 [https://glc.yale.edu/sites/default/files/pdf/the_bellagio_harvard_guidelines_on_the_](https://glc.yale.edu/sites/default/files/pdf/the_bellagio_harvard_guidelines_on_the_legal_parameters_of_slavery.pdf)
554 [legal_parameters_of_slavery.pdf](https://glc.yale.edu/sites/default/files/pdf/the_bellagio_harvard_guidelines_on_the_legal_parameters_of_slavery.pdf) [accessed 3 March 2020]
- 555 7. International Labour Organization (ILO). (1930). Forced Labour Convention, 1930 (No.
556 29).https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_IL
557 [O_CODE:C029](https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_IL)
- 558 8. United Nations (UN). (2000). Protocol to Prevent, Suppress and Punish Trafficking in
559 Persons, Especially Women and Children, supplementing the United Nations Convention
560 against Transnational Organized Crime.
561 [https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XVIII-12-](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XVIII-12-a&chapter=18&clang=_en)
562 [a&chapter=18&clang=_en](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XVIII-12-a&chapter=18&clang=_en)

- 563 9. ILO. (1999). Worst Forms of Child Labour Convention, 1999 (No. 182).
564 https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_C
565 ODE:C182
- 566 10. Maconachie, R., and Hilson, G. (2015). Re-thinking the child labor “problem” in rural
567 sub-Saharan Africa: The case of Sierra Leone’s half shovels. *World Dev* 78, 136-147.
- 568 11. Brown, D., Boyd, D. S., Brickell, K., Ives, C., Natarajan, N., and Parsons, L. (2019).
569 Modern slavery, environmental degradation and climate change: Fisheries, field, forests
570 and factories. *Environ Plann E. Advance online*. DOI: 10.1177/2514848619887156
- 571 12. Temper, L., del Bene, D., and Martinez-Alier, J. (2015). Mapping the frontiers and front
572 lines of global environmental justice: the EJAtlas. *J Political Ecol* 22, 255-278.
- 573 13. Bales, K. (2016). Blood and earth: Modern slavery, ecocide and the secret to saving the
574 planet (Spiegel & Grau).
- 575 14. Escobar, H. (22 Nov, 2019). Brazil’s deforestation is exploding – and 2020 will be worse.
576 *Science Magazine* [https://www.sciencemag.org/news/2019/11/brazil-s-deforestation-](https://www.sciencemag.org/news/2019/11/brazil-s-deforestation-exploding-and-2020-will-be-worse)
577 [exploding-and-2020-will-be-worse](https://www.sciencemag.org/news/2019/11/brazil-s-deforestation-exploding-and-2020-will-be-worse)
- 578 15. Wagner, L. (2016). Organized crime and illegally mined gold in Latin America (Global
579 Initiative against Transnational Organized Crime). [https://globalinitiative.net/wp-](https://globalinitiative.net/wp-content/uploads/2016/03/Organized-Crime-and-Illegally-Mined-Gold-in-Latin-America.pdf)
580 [content/uploads/2016/03/Organized-Crime-and-Illegally-Mined-Gold-in-Latin-](https://globalinitiative.net/wp-content/uploads/2016/03/Organized-Crime-and-Illegally-Mined-Gold-in-Latin-America.pdf)
581 [America.pdf](https://globalinitiative.net/wp-content/uploads/2016/03/Organized-Crime-and-Illegally-Mined-Gold-in-Latin-America.pdf)
- 582 16. Walk Free Foundation. (2016). The Global Slavery Index 2016 (The Minderoo
583 Foundation). [https://downloads.globalslaveryindex.org/ephemeral/GSI-2016-Full-Report-](https://downloads.globalslaveryindex.org/ephemeral/GSI-2016-Full-Report-1611276134.pdf)
584 [1611276134.pdf](https://downloads.globalslaveryindex.org/ephemeral/GSI-2016-Full-Report-1611276134.pdf)
- 585 17. Environmental Justice Foundation (EJF). (2015). Pirates and slaves: How overfishing in
586 Thailand fuels human trafficking and the plundering of our oceans (EJF).
587 https://ejfoundation.org/resources/downloads/EJF_Pirates_and_Slaves_2015_0.pdf

- 588 18. Boyd, D. S., Jackson, B., Wardlaw, J., Foody, G. M., Marsh, S., and Bales, K. (2018).
589 Slavery from space: Demonstrating the role for satellite remote sensing to inform
590 evidence-based action related to UN SDG number 8. *Int Soc Photogramme 142*, 380-388.
- 591 19. Allain, J., Crane, A., LeBaron, G., and Behbahani, L. (2013). Forced labour's business
592 models and supply chains (Joseph Rowntree Foundation).
593 <https://www.jrf.org.uk/sites/default/files/jrf/migrated/files/forced-labour-business-full.pdf>
- 594 20. van Uhm, D. P., and Nijman, R. C. C. (2020). The convergence of environmental crime
595 with other serious crimes: Subtypes within the environmental crime continuum. *Eur J*
596 *Criminol.* Advance online. DOI:10.1177/1477370820904585
- 597 21. de Coning, E. (2011). Transnational Organized Crime in the Fishing Industry (United
598 Nations Office on Drugs and Crime). [https://www.unodc.org/documents/human-](https://www.unodc.org/documents/human-trafficking/Issue_Paper_-_TOC_in_the_Fishing_Industry.pdf)
599 [trafficking/Issue_Paper_-_TOC_in_the_Fishing_Industry.pdf](https://www.unodc.org/documents/human-trafficking/Issue_Paper_-_TOC_in_the_Fishing_Industry.pdf)
- 600 22. Intergovernmental Panel on Climate Change. (2007). Summary for policymakers. In
601 *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to*
602 *the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, S.
603 Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H. L.
604 Miller, eds. (Cambridge University Press).
- 605 23. Decker Sparks, J. L., and Hasche, L. K. (2019). Complex linkages between forced labor
606 slavery and environmental decline in marine fisheries. *J Hum Rights 18*, 230-245.
- 607 24. Schaffartzik, A. (2018). Works in favor of extraction: labor in land-use competition.
608 *Sustainability 10*, 1961.
- 609 25. Bales, K. (1999). *Disposable people: New slavery in the global economy* 2nd edition
610 (University of California Press).
- 611 26. Downey, L., Bonds, E., and Clark, K. (2010). Natural resource extraction, armed
612 violence, and environmental degradation. *Org Environ 23*, 417-445.

- 613 27. UNICEF. (2015). The impact of climate change on children (UNICEF).
- 614 28. Coelho, S. (2016). The climate change-human trafficking nexus (International
615 Organization for Migration [IOM]).
616 https://publications.iom.int/system/files/pdf/mecc_infosheet_climate_change_nexus.pdf
- 617 29. Jackson, B., Decker Sparks, J. L., Brown, C., and Boyd, D. S. (2020). Understanding the
618 co-occurrence of tree loss and modern slavery to improve efficacy of conservation actions
619 and policies. *Conserv Sci Pract*, e183. DOI: 10.1111/csp2.183
- 620 30. Tickler, D., Meeuwig, J. J., Bryant, K., David, F., Forrest, J. A., Gordon, E., ... and
621 Zeller, D. (2018). Modern slavery and the race to fish. *Nat Commun* 9, 1-9.
- 622 31. Verité. (2016). Research on indicators of forced labor in the supply chain of shrimp in
623 Bangladesh (Verité). [https://www.verite.org/wp-content/uploads/2016/11/Research-on-
624 Indicators-of-Forced-Labor-in-the-Bangladesh-Shrimp-Sector__9.16.pdf](https://www.verite.org/wp-content/uploads/2016/11/Research-on-Indicators-of-Forced-Labor-in-the-Bangladesh-Shrimp-Sector__9.16.pdf)
- 625 32. Nilsson, M., Griggs, D., and Visbeck, M. (2016). Policy: Map the interactions between
626 Sustainable Development Goals. *Nature* 534, 320-322.
- 627 33. International Council for Science (ICSU). (2017). A guide to SDG interactions: from
628 science to implementation (ICSU). [https://council.science/publications/a-guide-to-sdg-
629 interactions-from-science-to-implementation/](https://council.science/publications/a-guide-to-sdg-interactions-from-science-to-implementation/)
- 630 34. Pradham, P., Costa, L., Rybski, D., Lucht, W., and Kropp, J. P. (2017). A systematic
631 study of Sustainable Development Goal (SDG) interactions. *Earth's Future* 5, 1169-1179.
- 632 35. Nilsson, M., Chisholm, M., Griggs, D., Howden-Chapman, P., McCollum, D., Messerli,
633 P., Neumann, B., Stevance, A-S., Visbeck, M., and Stafford-Smith, M. (2018). Mapping
634 interactions between the sustainable development goals: Lessons learned and ways
635 forward. *Sustain Sci* 13, 1489-1503.
- 636 36. Singh, G. G., Cisneros-Montemayor, A. M., Swartz, W., Cheung, W., Guy, J. A., Kenny,
637 T., McOwen, C. J., Asch, R., Geffert, J. L., Wabnitz, C. C., et al. (2018). A rapid

- 638 assessment of co-benefits and trade-offs among the Sustainable Development Goals. *Mar*
639 *Policy* 93, 223-231.
- 640 37. Weitz, N., Carlsen, H., Nilsson, M., and Skånberg, K. (2018). Towards systemic and
641 contextual priority setting for implementing the 2030 agenda. *Sustain Sci* 13, 531-548.
- 642 38. van Soest, H. L., van Vuuren, D. P., Hilaire, J., Minx, J. C., Harmsen, M. J., Krey, V.,
643 Popp, A., Riahi, K., and Luderer, G. (2019). Analysing interactions among Sustainable
644 Development Goals with integrated assessment models. *Glob Transit* 1, 210-225.
- 645 39. Hickel, J. (2019). The contradiction of the sustainable development goals: Growth versus
646 ecology on a finite planet. *Sustain Dev* 27, 873-884.
- 647 40. Gallagher, A. T. (2017). What's wrong with the Global Slavery Index? *Anti-Trafficking*
648 *Review* 8, 90-112.
- 649 41. Mendoza, M., Mcdowell, R., Mason, M., and Htusan, E. (2016). Fisherman slaves:
650 Human trafficking and the seafood we eat. AP Editions
651 [https://apimagesblog.com/blog/2016/05/02/fisherman-slaves-human-trafficking-and-the-](https://apimagesblog.com/blog/2016/05/02/fisherman-slaves-human-trafficking-and-the-seafood-we-eat)
652 [seafood-we-eat](https://apimagesblog.com/blog/2016/05/02/fisherman-slaves-human-trafficking-and-the-seafood-we-eat)
- 653 42. EJF. (2010). All at sea (EJF). [https://ejfoundation.org/resources/downloads/report-all-at-](https://ejfoundation.org/resources/downloads/report-all-at-sea_0_1.pdf)
654 [sea_0_1.pdf](https://ejfoundation.org/resources/downloads/report-all-at-sea_0_1.pdf)
- 655 43. Couper, A., Stanberry, B., Walsh, C., and Boerne, G. L. (1999). *Voyages of abuse:*
656 *Seafarers, human rights and international shipping* (Pluto Press).
- 657 44. Whitlow, J. (2004). The social dimension of IUU fishing. In *Fish piracy: Combatting*
658 *illegal, unreported, and unregulated fishing* (Organisation for Economic Co-Operation
659 and Development).
- 660 45. United Nations Thematic Working Group on Migration in Thailand. (2019). *Thailand*
661 *migration report 2019* (IOM).

662 https://reliefweb.int/sites/reliefweb.int/files/resources/Thailand%20Report%202019_2201
663 [2019_LowRes.pdf](#)

664 46. LeBaron, G. (2018, November 1-3). *Corporate fairytales versus workers' power*
665 [conference presentation]. Fighting Modern Slavery: What Works? The Gilder Lehrman
666 Center's 20th Annual Conference, New Haven, CT, United States.

667 47. ILO and Walk Free Foundation. (2017). Global estimates of modern slavery: Forced
668 labour and forced marriage (ILO).
669 https://www.alliance87.org/global_estimates_of_modern_slavery-
670 [forced_labour_and_forced_marriage.pdf](#)

671 48. Allen, C., Metternicht, G., and Wiedmann, T. (2019). Prioritising SDG targets: Assessing
672 baselines, gaps and interlinkages. *Sustain Sci* 14, 421-438.

673 49. McCollum, D. L., Gomez Echeverri, L., Busch, S., Pachauri, S., Parkinson, S., Rogelj, J.,
674 Krey, V., Minx, J. C., Nilsson, M., Stevance, A-S, et al. (2018). Connecting the
675 sustainable development goals by their energy inter-linkages. *Environ Res Lett* 13,
676 033006.

677 50. Jamarillo, F., Desormeaux, A., Hedlund, J., Jawitz, J. W., Clerici, N., Piemontese, L.,
678 Rodriguez-Rodriguez, J. A., Anaya, J. A., Blanco-Libreros, J. F., Borja, S., et al. (2019).
679 Priorities and interactions of Sustainable Development Goals (SDGs) with focus on
680 wetlands. *Water* 11, 619.

681 51. Weitz, N., Carlsen, H., Nilsson, M., Skånberg, K. (2018). Towards systemic and
682 contextual priority setting for implementing the 2030 Agenda. *Sustain Sci* 13, 531-548.

683 52. Pedercini, M., Arquitt, S., Collste, D., and Herren, H. (2019). Harvesting synergy from
684 sustainable development goal interactions. *PNAS* 116, 23021-23028.

- 685 53. Myers, L., and Theytaz-Bergman, L. (2017). The neglected link: Effects of climate
686 change and environmental degradation on child labour (Terre des Hommes).
687 <https://reliefweb.int/sites/reliefweb.int/files/resources/CL-Report-2017-engl.pdf>
- 688 54. Verité. (2017). Risk analysis of labor violations among farmworkers in the Guatemalan
689 sugar sector (Verité). [https://www.verite.org/wp-](https://www.verite.org/wp-content/uploads/2017/07/Verite_Guatemala_Sugar_Report_July_2017.pdf)
690 [content/uploads/2017/07/Verite_Guatemala_Sugar_Report_July_2017.pdf](https://www.verite.org/wp-content/uploads/2017/07/Verite_Guatemala_Sugar_Report_July_2017.pdf)
- 691 55. Verité. (2013). Risk analysis of indicators of forced labor and human trafficking in illegal
692 gold mining in Peru (Verité). [https://www.verite.org/wp-](https://www.verite.org/wp-content/uploads/2016/11/Indicators-of-Forced-Labor-in-Gold-Mining-in-Peru_0.pdf)
693 [content/uploads/2016/11/Indicators-of-Forced-Labor-in-Gold-Mining-in-Peru_0.pdf](https://www.verite.org/wp-content/uploads/2016/11/Indicators-of-Forced-Labor-in-Gold-Mining-in-Peru_0.pdf)
- 694 56. Brickell, K., Parsons, L., Natarajan, N. and Chann, S. (2018). Blood bricks: untold stories
695 of modern slavery and climate change from Cambodia (Royal Holloway, University of
696 London).
- 697 57. Malinowski, R. L., and Schulze, M. (2017). Natural disaster, human trafficking and
698 displacement in Kenya (HAART). [https://haartkenya.org/wp-](https://haartkenya.org/wp-content/uploads/2018/11/Malinowski-and-Schulze-2017.pdf)
699 [content/uploads/2018/11/Malinowski-and-Schulze-2017.pdf](https://haartkenya.org/wp-content/uploads/2018/11/Malinowski-and-Schulze-2017.pdf)
- 700 58. Laczko, F, and Aghazarm, C. (eds). (2009). Migration, environment, and climate:
701 Assessing the evidence (IOM).
- 702 59. Brown, O. (2008). Migration and climate change. IOM Report No. 31 (IOM).
703 [https://olibrown.org/wp-content/uploads/2019/01/2008-Migration-and-Climate-Change-](https://olibrown.org/wp-content/uploads/2019/01/2008-Migration-and-Climate-Change-IOM.pdf)
704 [IOM.pdf](https://olibrown.org/wp-content/uploads/2019/01/2008-Migration-and-Climate-Change-IOM.pdf)
- 705 60. Forsyth, T. (2018). Is resilience to climate change socially inclusive? Investigating
706 theories of change processes in Myanmar. *World Dev* *111*, 13-26.
- 707 61. Scott, Z. (2008). Climate change and social exclusion (Governance and Social
708 Development Resource Centre). <http://gsdrc.org/docs/open/hd501.pdf>

- 709 62. Branford, S. and Torres, M. (2017, March 15). Crime and not enough punishment:
710 Amazon thieves keep stolen public land. Mongabay
711 [https://news.mongabay.com/2017/03/crime-and-not-enough-punishment-amazon-thieves-](https://news.mongabay.com/2017/03/crime-and-not-enough-punishment-amazon-thieves-keep-stolen-public-land/)
712 [keep-stolen-public-land/](https://news.mongabay.com/2017/03/crime-and-not-enough-punishment-amazon-thieves-keep-stolen-public-land/)
- 713 63. Brown, C., Daniels, A., Boyd, D. S., Sowter, A., Foody, G., & Kara, S. (2020).
714 Investigating the potential of radar interferometry for monitoring rural artisanal cobalt
715 mines in the Democratic Republic of the Congo. *Sustainability* 12, 9834.
- 716 64. Walk Free Foundation. (2018). Global Slavery Index. Data. Congo, Democratic Republic
717 of the. <https://www.globalslaveryindex.org/2018/data/maps/#prevalence>
- 718 65. He, Y. (2019). Human trafficking risks and energy poverty (UN Economic and Social
719 Commission for Western Asia).
- 720 66. Anantharaman, M. Critical sustainable consumption: a research agenda. *J Environ Stud*
721 *Sci* 8, 553-561.
- 722 67. Amnesty International. (2016). The great palm oil scandal (Amnesty International).
723 <https://www.amnesty.org/download/Documents/ASA2151842016ENGLISH.PDF>
- 724 68. Rainforest Foundation Norway and Future in Our Hands. (2018). Salmon on soy beans –
725 deforestation and land conflict in Brazil (Rainforest Foundation Norway).
726 [https://www.framtiden.no/aktuelle-rapporter/849-salmon-on-soy-beans-deforestation-and-](https://www.framtiden.no/aktuelle-rapporter/849-salmon-on-soy-beans-deforestation-and-land-conflict-in-brazil/file.html)
727 [land-conflict-in-brazil/file.html](https://www.framtiden.no/aktuelle-rapporter/849-salmon-on-soy-beans-deforestation-and-land-conflict-in-brazil/file.html)
- 728 69. Otañez, M., and Glantz, S. A. (2011). Social responsibility in tobacco production?
729 Tobacco companies use of green supply chains to obscure the real costs of tobacco
730 farming. *Tobacco Control* 20, 403-411.
- 731 70. EJF. (2019). Blood and water: Human rights abuse in the global seafood industry (EJF).
732 <https://ejfoundation.org/resources/downloads/Blood-water-06-2019-final.pdf>

- 733 71. United States Department of State (USDoS). (2014). The intersection between
734 environmental degradation and human trafficking (USDOS). [https://2009-](https://2009-2017.state.gov/documents/organization/228266.pdf)
735 [2017.state.gov/documents/organization/228266.pdf](https://2009-2017.state.gov/documents/organization/228266.pdf)
- 736 72. Jackson, B., Bales, K., Owen, S., Wardlaw, J., and Boyd, D. S. (2018). Analysing slavery
737 through satellite technology: how remote sensing could revolutionise data collection to
738 help end modern slavery. *J Modern Slavery 4*, 169-199.
- 739 73. Landman, T. (2020). Measuring modern slavery: law, human rights, and new forms of
740 data. *Hum Rights Q 42*, 303-331.
- 741 74. Nuttall, W. J. (2010). Slaves to oil: exploring parallels between the abolition of slavery
742 and the challenge of climate change mitigation. In *Energy and Innovation: Structural*
743 *Change and Policy Implications*, M. van Geenhuizen, W. J. Nuttall, D. Gibson, and E.
744 Oftedal eds. (Purdue University Press), pp. 121-134.
- 745 75. Wallsgrove, R. (2013). What can the abolition of slavery teach us about climate change?
746 Location action in the liquefied natural gas controversy. *U Haw Law Review 35*, 687-
747 714.
- 748 76. Brack, D. (2019). Target agricultural supply chains to tackle deforestation. Chatham
749 House [https://www.chathamhouse.org/2019/06/target-agricultural-supply-chains-tackle-](https://www.chathamhouse.org/2019/06/target-agricultural-supply-chains-tackle-deforestation)
750 [deforestation](https://www.chathamhouse.org/2019/06/target-agricultural-supply-chains-tackle-deforestation)
- 751 77. Foody, G. M., Ling, F., Boyd, D. S., Li, X., and Wardlaw, J. (2019). Earth observation
752 and machine learning to meet Sustainable Development goal 8.7: mapping sites
753 associated with slavery from space. *Remote Sens 11*, 266.
- 754 78. Survivor Alliance. (2020). Nothing about us, without us. Survivor involvement in anti-
755 slavery policy making: guidance for policy makers (University of Nottingham Rights
756 Lab).

757 https://www.antislaverycommissioner.co.uk/media/1395/rights_lab_survivor_involvement_guide_final_2020.pdf

758

759 79. Griffin, A., and Bales, K. (2020). Social progress and responsible business practice: A
760 study on Outland Denim's cut and sew facility in Cambodia (2019) (University of
761 Nottingham Rights Lab). [https://www.nottingham.ac.uk/research/beacons-of-](https://www.nottingham.ac.uk/research/beacons-of-excellence/rights-lab/resources/reports-and-briefings/2020/october/social-progress-and-responsible-business-practice.pdf)
762 [excellence/rights-lab/resources/reports-and-briefings/2020/october/social-progress-and-](https://www.nottingham.ac.uk/research/beacons-of-excellence/rights-lab/resources/reports-and-briefings/2020/october/social-progress-and-responsible-business-practice.pdf)
763 [responsible-business-practice.pdf](https://www.nottingham.ac.uk/research/beacons-of-excellence/rights-lab/resources/reports-and-briefings/2020/october/social-progress-and-responsible-business-practice.pdf)

764 80. Datta, M., and Bales K. (2013). Slavery is bad for business: analysing the impact of
765 slavery on national economies. *The Brown Journal of World Affairs* 19, 205-224.

766 81. United Kingdom. (2015). Modern Slavery Act 2015.
767 <http://www.legislation.gov.uk/ukpga/2015/30/contents/enacted>

768 82. Boserup, E. (1995). *Woman's role in economic development* (Earthscan Publications).

769 83. UN Development Programme (UNDP). (2019). Gender equality as an accelerator for
770 achieving the SDGs. [https://www.undp.org/content/undp/en/home/librarypage/womens-](https://www.undp.org/content/undp/en/home/librarypage/womens-empowerment/gender-equality-as-an-accelerator-for-achieving-the-sdgs.html)
771 [empowerment/gender-equality-as-an-accelerator-for-achieving-the-sdgs.html](https://www.undp.org/content/undp/en/home/librarypage/womens-empowerment/gender-equality-as-an-accelerator-for-achieving-the-sdgs.html)

772 84. McGrath, S., and Watson, S. (2018). Anti-slavery as development: A global politics of
773 rescue. *Geoforum* 93, 22-31.

774 85. Cockayne, J. (2015). *Unshackling development: Why we need a global partnership to end*
775 *modern slavery* (United Nations University).

776 86. Jackson, B., and Decker Sparks, J. L. (2020). Ending slavery by decarbonisation?
777 Exploring the nexus of modern slavery, deforestation, and climate change action via
778 REDD+. *Energy Res and Soc Sci* 69, 101610.

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Figure Legends

Figure 1. Interactions between SDG Target 8.7 and Environmental Targets Comparison of number and type of interactions between 8.7 and the environmental targets of the SDGs.

Figure 2. Heat Map of Interactions by Country Number of interactions per country as identified in the records. *Note:* Some records only identified interactions at the global or regional (e.g. Southeast Asia) scale and thus were not included in the heat map.

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Tables

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813 **Table 1.** Selected SDG Indicators for Assessment

Goal	Target	Truncated description
	6.1	Equitable access to safe drinking water
	6.3	Improve water quality by reducing pollution
6	6.4	Reduce number of people suffering from water scarcity
	6.6	Protect water related ecosystems
	7.1	Universal access to modern energy (including clean energy)
7	7.2	Increase renewable energy
9	9.4	Upgrade infrastructure and retrofit industries to make them sustainable
	11.5	Reduce the number of people affected by disasters
11	11.b	Increase number of cities and settlements resilient to disasters
	12.2	Sustainable management and efficient use of natural resources
12	12.4	Environmentally sound management of chemicals and wastes
	13.1	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters
13	13.2	Integrate climate change measures into national policies, strategies, and planning
	13.3	Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
	14.2	Sustainably manage and protect marine and coastal ecosystems
14	14.4	End overfishing and illegal, unreported and unregulated fishing

	14.6	Prohibit certain forms of fisheries subsidies
	15.1	Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services
	15.2	Halt deforestation
15	15.3	Combat desertification
	15.5	Reduce degradation of natural habits and halt biodiversity
	15.7	End poaching and trafficking of protected flora and fauna

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815 **Table 2.** Sustainable Development Goal Scoring Adapted from Nilsson et al. (p. 321)³²

Interaction	Name	Nilsson et al.'s Explanation	Our Application to Nexus
+3	Indivisible	Inextricably linked to the achievement of another goal.	Environmental degradation and/or climate change was identified as the root cause or primary driver of modern slavery; therefore, if progress was made on the environmental SDG target we would expect to see progress on 8.7. Or modern slavery was identified as the root cause or primary driver of environmental degradation; therefore, if progress was made on 8.7 we would expect to see progress on the environmental SDG target

+2	Reinforcing	Aids the achievement of another goal.	Environmental degradation and/or climate change was identified as a factor or secondary or tertiary driver of modern slavery; therefore, if progress was made on the environmental SDG target we would expect to see progress on 8.7. Or, modern slavery was identified as a secondary or tertiary driver or factor of environmental degradation; therefore, if progress was made on 8.7 we would expect to see progress on the environmental SDG target
+1	Enabling	Creates conditions that further another goal.	There was an indirect relationship in that environmental degradation and/or climate exacerbate root causes of modern slavery or modern slavery amplifies other sources of environmental degradation. Therefore by making progress on one target, you may indirectly benefit the other target.
0	Consistent	No significant positive or negative interaction	A cursory interaction was noted, but supporting evidence was not yet detailed enough to disentangle the direction and strength.

-1	Constraining	Limits options on another goal	There was an indirect trade-off in that the cumulative effects of progress on one target would erode progress on the other.
-2	Counteracting	Clashes with another goal	Progress on one target directly reduces advances toward achieving the other.
-3	Cancelling	Makes it impossible to reach another goal	Progress on one target completely neutralizes progress on the other.