1   Growing Evidence of the Interconnections between Modern Slavery, Environmental

2   Degradation, and Climate Change

3

Authors: Jessica L. Decker Sparks[a], Doreen S. Boyd[a,b], Bethany Jackson[a,b], Christopher D. Ives[b], and Kevin Bales[a,c].

Affiliations and Addresses:

[a]The Rights Lab, Highfield House, University of Nottingham, University Park, Nottingham, Nottinghamshire NG7 2RD, UK.

[b]School of Geography, Sir Clive Granger Building, University of Nottingham, University Park, Nottingham, Nottinghamshire NG7 2RD, UK.

[c]School of Politics & International Relations, Law and Social Sciences building, University of Nottingham, University Park, Nottingham, Nottinghamshire, NG7 2RD, UK.

Corresponding Author:

Jessica L Decker Sparks, email: jessica.sparks@nottingham.ac.uk, (t): +44 (0) 115 82 83072, (f): +44 (0) 115 951 3666

4

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.

18

19

20

21

22

23

24

25

26

Introduction

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

In this perspective we explored how linkages facilitating a modern slavery-environmental degradation–climate change nexus may influence achievement of the SDGs. Using an adapted SDG interaction framework to synthesize expert judgement, we assessed the strength of interactions between SDG 8.7 and targets from SDGs 6, 7, 9, 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.

54

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 Amazon[13] where illegal deforestation is increasing[14]; in remote areas of Latin

85   America where illegal mining (sometimes state sanctioned) flourishes in conflict zones[15]; 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 depleted[17]; 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 CO_2 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 CO_2 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 campaign[41] 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.'s[32] 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 assessment[33], 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 researchers[32] 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

SDG 7: Affordable and Clean Energy

SDG 7 was the only goal with targets that overall negatively interacted with 8.7 (Table S6). Clean and renewable energies are touted as necessary to reduce CO_2 emissions and mitigate global warming; yet, progress on increasing renewable energy (target 7.2) is likely to counteract progress toward eliminating modern slavery due to the surge in demand for cobalt in renewable energy storage. Cobalt is mined in limited geographies, with the Democratic Republic of the Congo the world's largest supplier producing an estimated 60-70% of all cobalt.[63] The DRC is also one of the most impoverished countries in the world with poor governance, ongoing conflict, and is also estimated to have the 12th highest prevalence of modern slavery in the world.[64] Here the worst forms of child labour occur in both legal and illegal industrial and artisanal mines alongside debt bondage and forced labour as families facing abject poverty cannot afford to pay for their children's education and few other livelihood opportunities exist. To date, it is difficult to ensure "clean" cobalt from the DRC, though this negative interaction could be potentially mitigated or even reversed with appropriate and innovative action from both governments and the private sector.[63]

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

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 Boserup[82]

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 tools[86] to prevent undermining environmental objectives. Applying a modern slavery

522   lens will help accelerate sustainable development and the achievement of the SDGs.

523

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

538

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-

544   goals-2/

545 3. Bales, K. (2006). Testing a theory of modern slavery (Free the Slaves).

546   https://lastradainternational.org/lsidocs/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.globalslaveryindex.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_

554   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

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-

562   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-

577   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-

580   content/uploads/2016/03/Organized-Crime-and-Illegally-Mined-Gold-in-Latin-

581   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-

584   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-

599   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

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/

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-

652   seafood-we-eat

653   42. EJF. (2010). All at sea (EJF). https://ejfoundation.org/resources/downloads/report-all-at-

654   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., Nillson, 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-

690   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-

693   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-

699   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-

704   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-

712   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-

727   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-

735   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-

750   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_involvemen

758   t_guide_final_2020.pdf

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-

762   excellence/rights-lab/resources/reports-and-briefings/2020/october/social-progress-and-

763   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-

771   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.

779

780

781

782

783   **Figure Legends**

784

785   **Figure 1. Interactions between SDG Target 8.7 and Environmental Targets** Comparison

786   of number and type of interactions between 8.7 and the environmental targets of the SDGs.

787

788   **Figure 2. Heat Map of Interactions by Country** Number of interactions per country as

789   identified in the records. *Note*: Some records only identified interactions at the global or

790   regional (e.g. Southeast Asia) scale and thus were not included in the heat map.

791

792

793

794

795

796

797

798

799

800

801

802

803

804

805

806

807

808

809

810

Tables

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
	13.2	Integrate climate change measures into national policies, strategies, and planning
13	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

814

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.
+2			

-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.

816