



Accountability for Gender Equality in Education
Working Paper

**Girls' education and climate change:
A critical review of the literature**

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July 2022

AGEE: Accountability for Gender Equality in Education

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Suggested citation: Pankhurst, C. (2022) 'Girls' education and climate change: A critical review of the literature', *Accountability for Gender Equality in Education (AGEE) Working Paper*, London: Centre for Education and International Development, UCL.

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Acronyms	
CA	Capability Approach
CF	Conceptual framework
COP	Conference of the Parties
EPPI	Evidence for Policy and Practice Information
GHG	Greenhouse gases
IDMC	Internal Displacement Monitoring Centre
IPCC	Intergovernmental Panel on Climate Change
LICs	Low-Income Countries
LLMICs	Low- and Lower-middle Income Countries
LMICs	Low- and Middle-Income Countries
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

Abstract

Girls' education is often positioned as a panacea for a host of the world's problems. As the UK Prime Minister put it at the Global Education Summit: 'This is the silver bullet, this is the magic potion, this is the panacea. This is the universal cure, this is the Swiss Army knife, complete with allen key and screwdriver and everything else that can solve virtually every problem that afflicts humanity' (Prime Minister's Office, 10 Downing Street, 2021). One such problem is climate change. Girls' education is heralded for its ability to improve individuals' and countries' resilience, to instil environmental concern and behaviours, and to produce tomorrow's green workers and leaders. Perhaps the most pervasive claimed benefit of girls' education is of a relationship with slowed population growth and reduced emissions, which has led some to position educating girls as one of the most cost-effective climate mitigation strategies (Project Drawdown, n.d.).

But are these claims true? If we educated every girl, would we slow, halt and eventually reverse climate change and literally save the world? And what does the narrative of girls' education as climate change inoculation mean in the context of the learning, climate, and COVID-19 crises?

This paper outlines the findings of a rigorous review into the research question: 'what evidence is there in low and lower-middle income countries (LLMICs) of the pathways between girls' education and climate change?'. The review includes 98 studies published from 2012 to January 2022. I offer a new conceptual framework which sets out multiple, layered pathways between girls' education and climate change, and map included studies against this framework. An assessment of the quality of studies enables identification of areas of relative strength and weakness in the evidence base.

The review highlights that while there is evidence of a relationship between girls' education and climate change in LLMICs, the evidence base is limited and inconsistent. It exposes important gaps for widely assumed causal links of girls' education on climate change and highlights the need for further, high quality research in diverse contexts.

Introduction

Climate change has been heralded as ‘the defining issue of our time’ (United Nations, 2021) and there is ‘unequivocal’ evidence that human activity has warmed the atmosphere, oceans, and land (IPCC, 2021). Studies indicate that climate change has a detrimental effect on women and girls in low and lower middle-income countries (LLMICs) and point to educating girls as part of the solution to addressing it (Sims, 2021). Some have gone so far as to position girls’ education as one of the most cost-effective climate mitigation strategies (Project Drawdown, n.d.; Wheeler and Hammer, 2010). This paper interrogates the evidence base on the relationship between climate change and girls’ education.

The nature of the problem

Climate change is fundamentally unjust. While anthropogenic climate change has been driven by higher-income countries over the course of centuries, its burdens fall disproportionately on LLMICs (IPCC, 2014; 2018; 2021; UNDP, 2020) who have historically produced, and continue to produce, low emissions (Bohm, 2015; Ritchie and Roser, 2020). Within those countries, the poorest households in poorest regions are hardest hit. The World Bank has estimated that climate change could push 132 million people into poverty in the next decade alone (World Bank, 2021a) and on current trajectories it is practically inevitable that gains in reducing poverty will be reversed (Khoday, 2020; Raworth, 2017; UNDP, 2020). Children will bear the brunt of climate change’s impacts. Modelling conducted in 2021 found that:

‘A child born in 2020 will experience on average twice as many wildfires, 2.8 times the exposure to crop failure, 2.6 times as many drought events, 2.8 times as many river floods, and 6.8 times more heatwaves across their lifetimes, compared to a person born in 1960’ (Save the Children, 2021).

The impacts of climate change are diverse. Extreme weather events are increasing in frequency and severity (IPCC, 2012; 2014; World Meteorological Organization, 2021) and cause huge loss of life. Over 95% of disaster-related deaths occurred in LLMICs between 1970 and 2008 (IPCC, 2012). In 2019, extreme weather events drove 23.9 million people from their homes (IDMC, 2020a). Extreme weather events

have an immediate impact on education, with schools and infrastructure destroyed or repurposed (Education Cannot Wait, 2019). Indirect effects include increased poverty, reduced water, sanitation and hygiene (WaSH) resources, forced displacement, and physical and mental illness (Kousky, 2016). These in turn affect education access and outcomes (Anderson, 2019; Chuang et al., 2018; Nordstrom and Cottom, 2020; Sims, 2021; Siriwardhana et al., 2013).

Slower onset impacts are no less important. Warming temperatures melt ice caps, leading to rising sea levels and increased flooding (IPCC, 2014; World Meteorological Organization, 2021). Harsher heat drives drought and desertification, affecting agriculture and water availability (*ibid*). Studies also point to the impact of heat and air pollution on learning outcomes (Harvard Kennedy School, 2018; Heissel, J. *et al.*, 2019).

Climate change is only part of the problem. Environmental degradation is also a global phenomenon driven by human activity but is most acutely felt in LLMICs due to the immediacy of reliance on natural ecosystems for food, fuel and livelihoods. As Bangay (2022: 4) outlines, the impacts of environmental degradation are accelerating in LLMICs which leads to a:

‘vicious spiral of declining productivity leading to poverty, malnutrition, increased disease burden and, in extreme cases, conflict and migration — all of which are known to have impacts on school attendance and learning attainment’.

Environmental degradation and climate change are inextricably linked but their pace and impacts are distinct and highly localised. Thus, the current preoccupation with climate change as a global crisis driven by GHG emissions risks obscuring the complexity of the different environmental crises facing communities worldwide, and can lead to a skewing of focus in terms of interventions and outcomes prioritised (Bangay, 2022). While ‘climate change’ is the term of choice for this paper, it should be read as an inclusive phrase which captures associated environmental degradation.

Women and girls are disproportionately impacted by climate change due to existing gender inequalities (Atkinson and Bruce, 2015; Chigwanda, 2016; Kwauk and Braga,

2017; Le Masson *et al.*, 2016; Malala Fund, 2021a; Rao *et al.*, 2019; Terry, 2009; UNDP, 2016; UN Women and UNICEF, 2019). Women and girls are more likely to die during natural disasters (Neumayer and Plumper, 2007). Climate change increases girls' domestic work, taking time away from school and study (Peek *et al.*, 2018). It reduces family income, exacerbating a major barrier to education for girls (Sims, 2021), and can lead to girls being married early (Alston *et al.*, 2014). When displaced by climate change, women and girls face risk of violence and exploitation (Swaine, 2018). The costs of responding to climate change shocks diverts resources away from efforts to drive education quality and gender equality; studies suggest that the costs of natural disasters in 2020 alone were \$210 billion (Dure, 2021).

Efforts to address climate change can broadly be grouped as mitigation and adaptation. Mitigation intends to slow GHG emissions and global warming to reduce the impact of climate change and ultimately reverse its negative effects (IPCC, 2012; 2014; 2018; 2021). However, the effects of GHG emissions are cumulative and global warming will continue to intensify for decades, making adaptation essential and urgent (IPCC, 2018). Adaptation is adjustment to actual or expected climate change effects and can either focus on avoiding harm or exploiting opportunities that have arisen, or could arise from climate change (IPCC, 2014).

Climate change and girls' education

Others have documented the rise of 'girls' education' since the 1960s as a solution to a whole host of the world's problems (Peppin Vaughan, 2019; Unterhalter, 2016). The Human Capital imperative that has been argued to have driven the expansion of girls' education since the 1960s remains influential today, as exemplified by the 2021 G7 Declaration on Girls' Education (UK Foreign, Commonwealth and Development Office, 2021), which states that;

'12 years of safe and quality education for all children, and specifically girls, is one of the most cost-effective and impactful social and economic investments governments and donors can make'.

In recent years climate change has been added to the list of problems to be solved by girls' education, although the evidence base remains limited (Sims, 2021; Devonald *et al.*, 2021a). The Human Capital imperative is present in the identification

of girls' education as a worthwhile 'investment' in combatting climate change. A predominant trope is the link between girls' education and slowed population growth, with a subsequent benefit in reducing GHG emissions. Modelled estimates have suggested that if universal education for girls were already achieved, the population in 2050 could be 1.5 billion people smaller than if girls' access remained the same as today; by 2100 that could represent 5.7 billion less people (Lutz, Butz, and Samir, 2014). Another dominant trope, introduced by eco-feminists in the 1970s, posits that women and girls' affinity with Mother Earth means that as leaders in the home, community, politics and economy they could enhance mitigation and adaptation (Ergas and York, 2012; Mavisakalyan and Tarverdi, 2018; McGee *et al.*, 2020; Norgard and York, 2005; Nugent and Shandra, 2009).

Countering the positioning of educated girls as a solution to climate change is a prevalent victim narrative, resulting in the relationship between girls' education and climate change being conceptualised as largely binary: Women and girls are simultaneously both victims and saviours of climate change (Arora-Jonsson, 2011).

Such linear connections are reductionist, essentialist, and problematic, simultaneously disempowering women and girls and placing responsibility for action on the wrong shoulders (Djoudi *et al.*, 2016; Jerneck, 2015; Kaijser and Kronsell, 2014). While gender is an important factor in experiences of climate change, it is not the only factor, and does not render all women or girls equal. Indeed, the 'intersectionality' of different characteristics such as gender, race, class and more makes every woman and girl unique and has an enormous impact on her lived reality (Crenshaw, 1991). Women and girls are active participants in shaping the world around them and are not homogenously helpless victims of climate change. Casting them as such risks obscuring the multiple, layered factors which render some women and girls (and men and boys) more vulnerable to climate change and leading to ineffective, potentially harmful, policy and practice (Meinzen-Dick *et al.*, 2014).

Conversely, suggestions that women are more inclined to care about the environment and to act in stewardship of nature (Leach, 2007) are problematic, and present discursively, historically, and socially constructed features of 'femininity' as natural. In doing so, they risk consigning women to positions of care and domestic labour (Lau *et al.*, 2021). Furthermore, narratives that connect girls' education to

slowed population growth and mitigation of climate change through reduced GHG emissions should be challenged on environmental justice grounds. As set out above, per capita emissions in LLMICs are a mere fraction of those in HICs, and LLMICs bear no historical responsibility for the warming climate. Placing the burden of saving the planet on the shoulders of women and girls' reduced reproductivity in LLMICs is thus unethical (Kwauk and Braga, 2017). However, as Bangay (2022) argues, the relationship between education, realisation of ideal family size, and locally experienced environmental issues such as degradation and pressure on resources merits further attention.

Aim, research questions, and structure

Through interrogation of the evidence base, this review seeks to expose the diverse and complex ways in which girls' education and climate change intersect. The research question guiding the review is: *'what evidence is there in low and lower-middle income countries (LLMICs) of the pathways between girls' education and climate change?'*

The remainder is structured in 4 sections. The first grounds the review within the Capability Approach and introduces a new conceptual framework, which maps multiple, layered pathways between girls' education and climate change. The following section outlines the methodology. The third section presents the results. The final section assesses the scope and strength of the evidence base, outlining gaps, areas for further research, and implications for policy and practice.

Theoretical framework

The Capability Approach, girls' education, and climate change

The guiding theoretical framework for this review is the Capability Approach (CA). Amartya Sen introduced the CA in the 1970s, as an alternative to the dominant development economics approach of Human Capital Theory (Walker and Unterhalter, 2007). In the CA: 'human beings are not only the most important *means*

of social achievement; they are also its profoundest *end* (Sen, 1998: 734, italics in original). Rather than measuring development solely through economic indicators, the CA considers 'development as freedom' (Sen, 1999) and focuses on whether individuals have the capabilities and functionings to live lives that they value (Sen, 1987; 1992). Here I briefly outline three concepts of the CA which are pertinent to the analysis that follows.

Girls at the centre

The foundational principle of humans as both means and ends of development invokes a particular approach to girls' education and climate change by putting human well-being centre stage. For the CA, education is first and foremost an intrinsic good as it enables girls to realise their potential (Saito, 2003). The focus is on how education can expand capabilities (for instance, through curriculum, pedagogy and other measures of quality) as opposed to what instrumental value education has (for instance, in reducing mortality or increasing economic growth) (Vaughan, 2007).

In the context of climate change, education's intrinsic importance is clear; it provides girls with the means to be resilient to, as well participate in efforts to mitigate and adapt to, climate change. Such a conceptualisation immediately exposes problems inherent in the discourse of girls' education for reduced emissions through slowed population growth, as this prioritises the instrumental value of educating girls for purposes other than their own.

Climate change is an 'unfreedom' (Khoday, 2020: 21) negatively affecting individuals' abilities to live lives they value (Kronlid, 2014). Impacts include ill-health, interrupted education, forced displacement, hunger, inequality and more. Indeed, environmental factors are outlined as one of three categories of 'conversion factors' in Robeyn's influential work (2005), and when climate change damages environments, individuals' ability to convert capabilities into functionings can be negatively impacted. Examples include the destruction of school infrastructure from flooding (buildings, roads) affecting access to education, or crop failure due to drought leading to children undertaking labour to provide family income.

Social justice

The CA's roots in social justice have a bearing on the burden of responsibility to address climate change. Responsibility for anthropogenic climate change lies largely with the 'developed' world, responsible for approximately 80% of carbon emissions (Bohm, 2015). In contrast, while Africa has been responsible for less than 0.01% of all emissions due to very low per capita emissions (*ibid.*), people living there are 500 times more likely to die from climate change related mortality than anywhere else in the world (Mersha, 2018).

International frameworks such as the Paris Agreement (United Nations, 2015) recognise this disparity and determine differential responsibility for climate change mitigation, with a higher burden falling on higher-income countries. Furthermore, these nations are obligated to support lower-income countries with mitigation and adaptation efforts (Pauw *et al.*, 2020).

Taking a social justice approach to climate change also suggests implications for the balance of attention between mitigation and adaptation (Jerneck, 2018). Currently, approximately 92 percent of climate financing goes to mitigation activities like renewable energy generation (UN Women, 2016). However, for poor girls in lower-income countries bearing the brunt of climate change, adaptation is an immediate need, and already coming too late for many.

Development as sustainable freedom?

While the CA offers routes through which to analyse the links between girls' education and climate change, there are also important tensions; notably, the position of nature in the CA. The centrality of humans in the CA relegates nature to a position of lesser importance, valuable predominantly for its contribution to the freedoms of people (Watene, 2016). However, this approach is not sustainable, and a new paradigm is needed to balance human development within the constraints of planetary boundaries (Raworth, 2017).

This poses a fundamental challenge to the CA. Indeed, 'what happens to the concept of human agency when humanity has revealed itself as an agent of planetary change?' (Khoday, 2018: 2). This is pertinent because there is a correlation between education, countries' income status and GHG emissions,

indicating that by reducing poverty, education could accelerate climate change (Lutz and Streissnig, 2015).

The main counterargument is ‘green growth’, which posits that development can continue so long as ‘grey’ economies are replaced by ‘green’ economies (Klein, 2014). For this, education is essential, as innovation is a proven externality (Lutz and Streissnig, 2015; UNDP, 2020), and on a micro level educated individuals will be needed to contribute to the green economy (Kwauk and Braga, 2017). Education is thus fundamental to enabling transformation towards a greener society, economy, and global world order. Or in the CA lexicon, ‘how many people the Earth can ultimately support is not only a question of population size, it also depends on the capabilities of those people inhabiting it’ (Lutz and Streissnig, 2015).

Green growth is not universally accepted as the solution (Khoday, 2020; Raworth, 2017). It *is* accepted that green skills and the green economy are fundamental to mitigation and adaptation. However, critics argue that without also addressing the systemic root causes of climate change including colonialism, environmental racism, capitalism and entrenched inequalities, the green growth agenda risks simply ‘greening capitalism’ (Huckle, 1993; Klein, 2014; Kwauk and Casey, 2021).

Evolutions of the human development paradigm which seek to address this tension are in development. Raworth’s (2017) ‘Doughnut Economics’ offers an economic model that eschews capitalism’s fundamental principle of growth, instead theorising the need for a closed loop where the inner ring represents the basic capabilities needed for human dignity and freedom and the outer ring represents the planetary boundaries. Raworth argues that it is possible to find a balance between these if we take a radical restorative and redistributive approach (*ibid.*). In addition, a new approach to measuring development with a Planetary pressure-adjusted Human Development Index (PHDI) has been developed (Hickel, 2020; Robeyns, 2020; UNDP, 2020). In this, countries’ ecological footprint is considered alongside their human development outcomes, to expose where previously high scoring countries achieve this due to their exploitation of the natural world and to praise countries who have achieved a more sustainable balance.

Therefore, grounding this report in the CA intends to ensure that analysis against the research question (*what evidence is there in low and lower-middle income countries*

(LLMICs) of the pathways between girls' education and climate change?) centres the diverse experiences of the girls whose lives and education are affected by climate change. It recognises the complex relationships that underpin disadvantage, positioning climate change as a social justice issue, and promoting investigation beyond binary and instrumental approaches to girls' education.

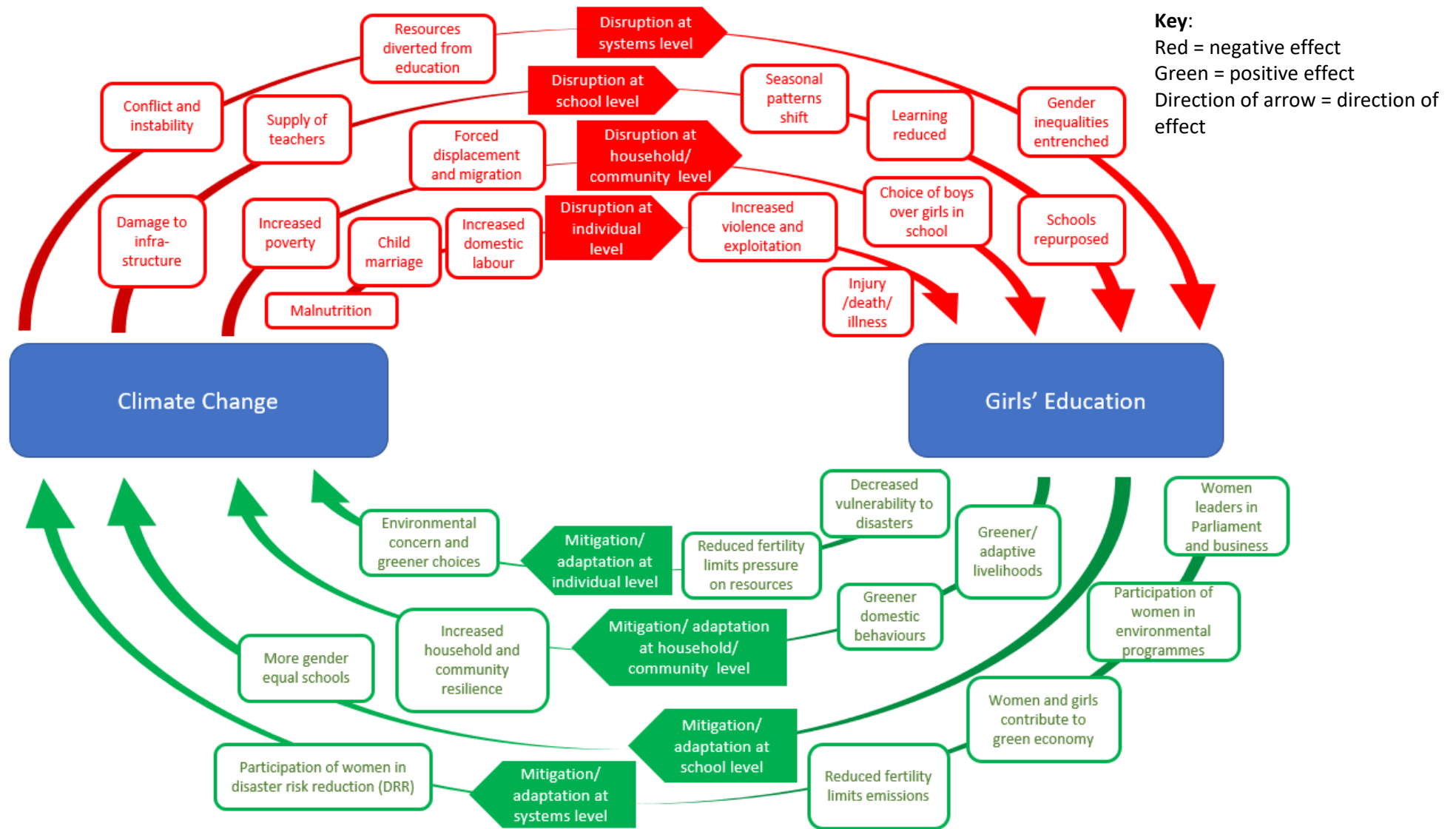
Conceptual framework

I have outlined that the dominant conceptualisation is of a binary relationship between girls' education and climate change. Through this report, I intend to expose this as overly simplified. Others have developed conceptual frameworks which speak to various elements of the connections between girls' education and climate change (Chigwanda, 2016; Kwauk *et al.*, 2017; Ledley *et al.*, 2017; Lutz *et al.*, 2014; Lutz and Streissnig, 2015; Meinzen-Dick *et al.*, 2014). An overview of these is at Appendix A.

However, existing frameworks do not provide a structure against which the research question can be fully answered. Some are too high level: Kwauk and Braga (2017) conceptualise the links between climate change, education and gender equality sectors, but do not attempt to determine cause or effect. Others are focussed on a limited dimension of the relationship: Lutz and Streissnig (2015) articulate the links between population control and climate change, while Muttarak and Lutz (2014) and Chigwanda (2016) demonstrate education's role in building resilience to climate change, but these tell only part of the story.

To address this gap, I have developed a new conceptual framework (CF), at Figure A. This CF visually depicts a wide range of relationships between girls' education and climate change. A recent evidence brief on the topic (Sims, 2021) provided source material, supplemented by reports published by The Brookings Institution (Chigwanda, 2016; Kwauk and Braga, 2017; Kwauk, 2020).

Figure A: Conceptual framework outlining multiple layered pathways between girls' education and climate change



The top half of the diagram outlines individual, household and community, school, and systems level impacts of climate change on girls' education to highlight the wide-ranging, often long-lasting, and overwhelmingly negative effects. Each 'bubble' represents a different outcome. This is not to say that women and girls are helpless victims with no agency to address these challenges, nor to signify that many of these impacts do not affect men and boys too. However, being a woman or girl is a risk-heightening factor for many of the bubbles.

The bottom half mirrors the top. Mitigation and adaptation are side by side to reflect the interconnectedness of drivers and responses to mitigation and adaptation and avoid artificial prioritisation of one over the other.

The remainder of this paper assesses to what extent the evidence base supports this CF.

Methodology

I have conducted a 'rigorous review' (BE2, 2020; Hagen-Zanker and Mallett, 2013). This borrows elements from a systematic review in that I interrogated multiple databases and searched bibliographies; screened studies for relevance; appraised their quality; and synthesised the findings (*ibid.*)¹.

Methods for the rigorous review

Literature search

The literature search consisted of three key pillars. Pillar 1 was a curated, peer-reviewed reference list drawing on 'academic research and literature from low- and middle-income countries (LMICs), as well as policy frameworks and grey literature, media articles and blogs from climate, education and gender fields' from a recent evidence brief produced for the Foreign, Commonwealth and Development Office

¹ The EPPI software was used to manage the references, enabling a systematic approach to literature analysis and synthesis. EPPI (Evidence for Policy and Practice Information) is the online tool carrying out literature reviews for research synthesis developed by the EPPI-Centre, UCL. See <https://eppi.ioe.ac.uk>

(Sims, 2021: 1). Pillar 2 was a targeted keyword search of SCOPUS, Web of Science and ERIC. Literature in English from 2012 to January 2022 was included. The approach taken to refine the strategy and final search strings are in Appendix B. This returned 531 results for inclusion. Pillar 3 undertook keyword searches in relevant websites for grey literature and selective ‘snowballing’. A list of websites searched is at Appendix B. The search strategy resulted in 683 studies being uploaded into the EPPI software. 152 duplicates were removed.

Inclusion criteria

Studies were screened first on title and abstract, and latterly on the full text, against the following criteria:

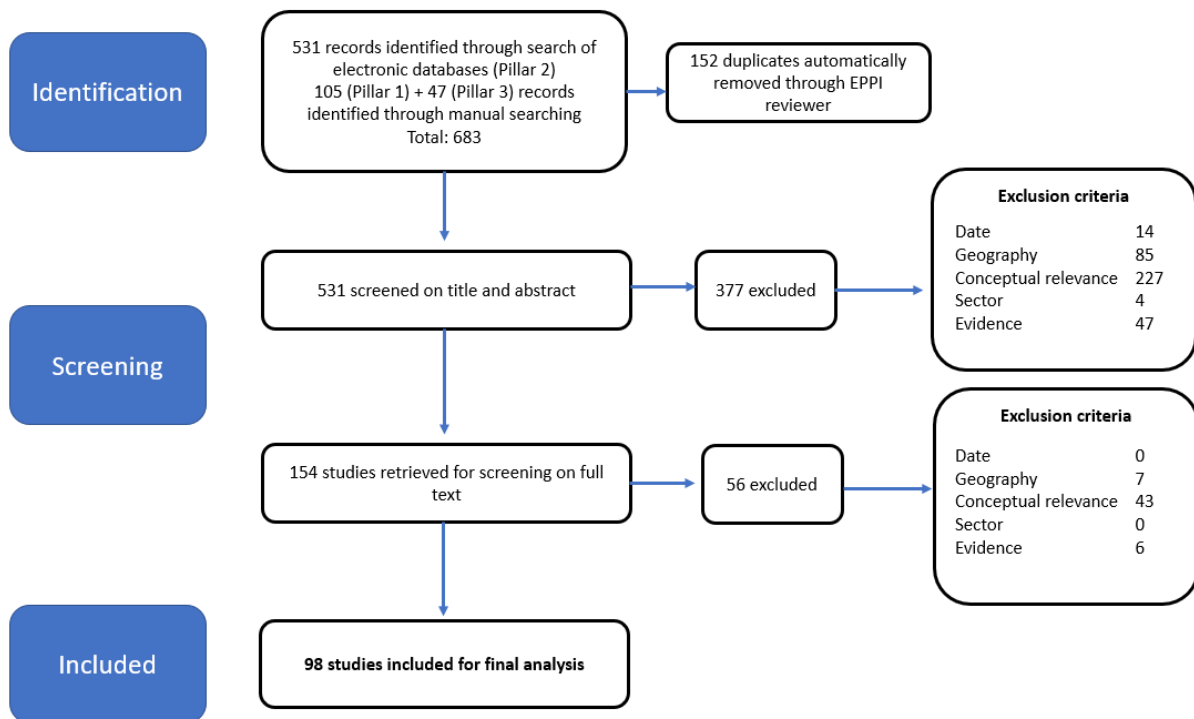
- i. **By geography:** Studies not primarily concerned with LLMICs according to World Bank (2021b) categorisation were excluded. Where studies were global a judgement was made as to their relevance to LLMICs.
- ii. **By conceptual relevance:** Studies that were not directly relevant to the research question or CF were excluded².
- iii. **By sector:** Studies that were not focussed on primary or secondary education were excluded.
- iv. **By evidence:** Studies that did not make sufficiently clear that they provided evidence for the research question were excluded³.
- v. **By language:** Studies that were not published in English were excluded.

98 studies were included for analysis after screening on full text. The diagram below outlines the PRISMA flow chart.

² Examples include studies on non-weather-related natural disasters; health, agriculture or nutrition specific studies without a clear education link; and studies that did not sufficiently address gender.

³ A decision was taken to include studies that, while primarily theoretical or conceptual evidently furthered the debate on girls’ education and climate change or had been cited as evidence for one of the pathways in the CF by other authors. These were analysed separately so as not to dilute the quality of the evidence base of the rigorous review but were not excluded entirely to ensure the review was in dialogue with the existing literature.

Figure B: PRISMA Flow Chart of the rigorous review



Literature analysis

A matrix was developed against which the studies were coded. This is in Appendix B. Studies were coded based on their geographic and conceptual focus, according to the pathways and ‘bubbles’ on the CF. Studies could be coded for more than one bubble. Coding determined whether the study was positive (confirming the CF), negative (refuting the CF) or mixed (neither confirming nor refuting the CF due to lack of evidence or mixed results).

Studies were labelled according to the BE2 (2020) classification, as either i) primary and empirical; ii) secondary; or iii) theoretical or conceptual. A quality assessment of primary and empirical studies was undertaken against domains of i) conceptual framing; ii) transparency; iii) methodology; iv) cultural appropriateness; v) validity; vi) reliability; and vii) cogency (*ibid.*) to provide a composite score of high, moderate or low quality. Secondary studies were assessed according to the BE2 (2020)

approach⁴. Studies classified as theoretical or conceptual were not assessed for quality.

Limitations

The targeted approach to the database search enabled the review to assess with some certainty the state of the evidence base that sets out to say something about the research question but will not have captured all relevant literature. Evidence from contexts where English is not the dominant language will have been excluded.

The fact that the review was conducted independently opens the possibility of subjectivity affecting the results (BE2, 2020). A comprehensive systematic review of this research question would remain of benefit to researchers, policy makers and practitioners.

Results

This section presents high-level characteristics of the studies included before mapping these against the CF in response to the research question. Two sets of results are presented. First, including all 98 studies, to demonstrate the full breadth of the literature that met the inclusion criteria (termed 'inclusive'). Second, a smaller set of 58 studies, excluding those classified as theoretical or conceptual, or which scored 'low' in terms of quality (termed 'exclusive'). This distinguishes the broader literature on girls' education and climate change from rigorous studies that constitute reliable evidence. An overview of all included studies is at Appendix C⁵.

⁴ i) Does the author state where they have searched for relevant studies to be included in the review?; ii) Does the author attempt any quality assessment of studies they found? iii) Are the study's findings demonstrably based on the studies it reviewed? (BE2, 2020: 15).

⁵ The references of all included studies are at Appendix E

Characteristics of the evidence base

Research methods and quality of literature

Table 1 outlines the research methods and quality scores for all included studies. Most studies were primary and empirical, and of these most followed an observational design. Only 3 experimental approaches were included. 2 exploited natural experiments following an extreme weather event and 1 created a lab-based experiment. The majority (20) of primary and empirical studies were published in journals focussed on the environment and an additional 6 were published in journals focussed on disasters. 15 studies were published in journals focussed on development and social sciences; of these 6 were published in *World Development Journal*. Only 1 study was published in an education-specific journal. The detailed quality scores for the primary and empirical studies can be found in Appendix D.

Of the 15 secondary studies included, 4 were systematic reviews. While these answered parts of the research question, none were wholly concerned with the links between girls' education and climate change.

The 21 theoretical or conceptual studies included were largely reports produced by UN and non-governmental organisations.

Table 1: Research methods and quality of literature

Method		No. of studies	Quality	
Primary and empirical	Observational	55	High	8
			Moderate	31
			Low	16
	Quasi-experimental	4	High	1
			Moderate	3
			Low	0
	Experimental	3	High	2
			Moderate	1
			Low	0
Subtotal		62		
Secondary	Systematic review	4	High	4
			Moderate	0
			Low	0
	Rigorous review	4	High	0

			Moderate	4
			Low	0
	Non-systematic review	7	High	0
			Moderate	4
			Low	3
Subtotal		15		
Theoretical or conceptual		21	N/A	
Total		98		

Geographical focus

Table 2 outlines the number of studies per country. The weighting of studies in favour of LMICs over LICs is striking, particularly as LICs are worse affected by climate change (UNDP, 2020). Within the LMICs, richer countries such as Kenya and India have more studies, suggesting a disparity in where research is conducted.

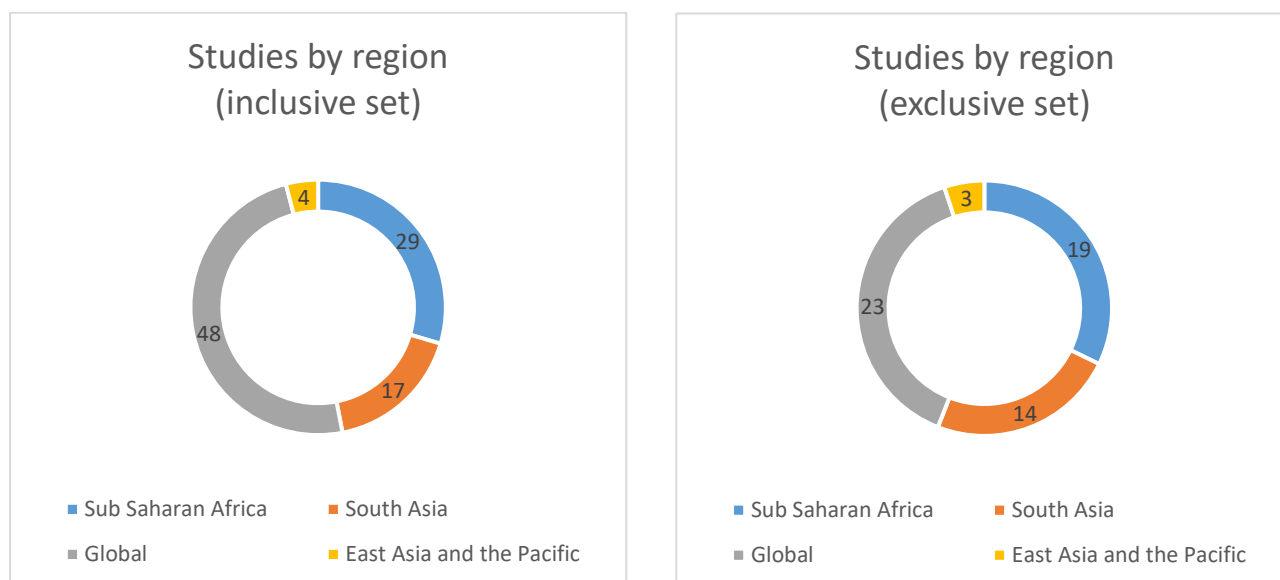
Table 2: Geographic focus of the literature

Countries	No. of studies (inclusive)	No. of studies (exclusive)
Multiple countries		
Sub Saharan Africa (where multiple countries)	8	7
South Asia (where multiple countries)	2	1
Global (developing)	48	23
Lower Middle Income Countries (LMICs)		
Bangladesh	5	5
Cambodia	1	1
Cameroon	1	1
Ethiopia	2	2
Ghana	1	1
India	5	5
Kenya	3	1
Nepal	3	1
Nigeria	2	1
Pacific Islands	1	1
Pakistan	1	1
Senegal	1	0
Sri Lanka	1	0
Tanzania	1	1
Vanuatu	1	1
Vietnam	1	0
Zambia	1	0
Zimbabwe	2	1

Low Income Countries (LICs)		
Chad	1	1
Democratic Republic of Congo	1	0
Eritrea	1	1
Madagascar	1	1
Mozambique	2	0
Uganda	1	1
Total	98	58

Figure C shows the breakdown of studies by region. The high number of ‘global’ studies is noteworthy. The proportion drops in the exclusive set because most theoretical and conceptual studies are not country specific. It is surprising no studies concerned with Latin America and Caribbean are included, as these regions are heavily affected by climate change. This could be due to the language criteria applied. Similarly, the number of studies from the Pacific Islands is small relative to their vulnerability to climate change impacts.

Figure C: Studies by region



Mapping studies against the Conceptual Framework

Table 3 details the conceptual focus of the literature, outlining the number of studies that speak to each ‘bubble’ of the CF. Figures D and E map this against the CF. The diagrams visually depict the volume and consistency of evidence included in the review. The thickness of the borders of the bubbles indicates the number of studies:

the thicker the line, the more included studies. The absence of a border signifies that no included studies provided evidence for that outcome. The type of border denotes the consistency of the included studies' findings. Where a bubble has a full border line, this signals that either all, or at least 80%, of the included studies were 'positive', or provided evidence that supports the CF. The dashed lines signal that at least 1 included study was 'negative' - refuting the CF - or at least 20% of the included studies were mixed. For example, in Figure D, more than 5 studies provided evidence for 'choice of boys over girls in school'. In the context of this review, this is a comparatively high number. However, the border is dashed, which signals inconsistency in the studies' findings.

Table 3: Conceptual focus of the literature

Inclusive set					Exclusive set				
Impacts of climate change on girls' education									
	Positive	Negative	Mixed	Total		Positive	Negative	Mixed	Total
Individual					Individual				
Child marriage	9	0	0	9	Child marriage	3	0	0	3
Injury/death/illness	13	0	0	13	Injury/death/illness	5	0	0	5
Increased domestic labour	9	1	1	11	Increased domestic labour	3	1	1	5
Increased violence and exploitation	9	0	0	9	Increased violence and exploitation	4	0	0	4
Malnutrition	13	0	0	13	Malnutrition	5	0	0	5
Household/community					Household/community				
Forced displacement/ migration	13	0	0	13	Forced displacement/ migration	5	0	0	5
Choice of boys over girls in school	6	1	3	10	Choice of boys over girls in school	2	1	0	3
Increased poverty	7	0	0	7	Increased poverty	3	0	0	3
School					School				
Schools repurposed	5	0	0	5	Schools repurposed	1	0	0	1
Seasonal patterns shift	0	0	0	0	Seasonal patterns shift	0	0	0	0
Learning reduced	1	0	0	1	Learning reduced	1	0	0	1
Supply of teachers	1	0	0	1	Supply of teachers	1	0	0	1
Damage to infrastructure	10	0	0	10	Damage to infrastructure	3	0	0	3
System					System				
Gender inequality entrenched	5	0	0	5	Gender inequality entrenched	4	0	0	4
Resources diverted from education	3	0	0	3	Resources diverted from education	1	0	0	1
Conflict and instability	3	0	0	3	Conflict and instability	1	0	0	1
Impacts of girls' education on climate change									
	Positive	Negative	Mixed	Total		Positive	Negative	Mixed	Total
Individual					Individual				
Decreased vulnerability to disasters	10	0	0	10	Decreased vulnerability to disasters	5	0	0	5

Reduced fertility limits pressure on resources and environmental degradation	3	0	2	5	Reduced fertility limits pressure on resources and environmental degradation	1	0	2	3
Increased environmental concern/greener life choices	6	2	2	10	Increased environmental concern/greener life choices	1	2	0	3
Household/community					Household/community				
Increased household and community preparedness and resilience	15	0	2	17	Increased household and community preparedness and resilience	9	0	2	11
Greener/more adaptive livelihoods	6	1	4	11	Greener/more adaptive livelihoods	3	1	4	8
Greener household behaviours	2	0	0	2	Greener household behaviours	1	0	0	1
School					School				
More gender equal schools	0	0	0	0	More gender equal schools	0	0	0	0
More climate resilient schools	2	0	0	2	More climate resilient schools	1	0	0	1
System					System				
Women's higher political and/or economic status associated with greener outcomes	8	0	1	9	Women's higher political and/or economic status associated with greener outcomes	6	0	1	7
Women's participation in environmental programmes increases their effectiveness	2	0	4	6	Women's participation in environmental programmes increases their effectiveness	1	0	3	4
Women contribute to the green economy	5	0	4	9	Women contribute to the green economy	1	0	0	1
Reduced fertility limits CO2 emissions	2	0	6	8	Reduced fertility limits CO2 emissions	0	0	3	3
Women's participation results in better DRR/lower vulnerability	1	0	1	2	Women's participation results in better DRR/lower vulnerability	1	0	0	1
Girls' education leads to increased emissions through consumption/urbanisation/aging population	1	0	4	5	Girls' education leads to increased emissions through consumption/urbanisation/aging population	1	0	1	2

Figure D: Mapping the literature against the Conceptual Framework (inclusive set)

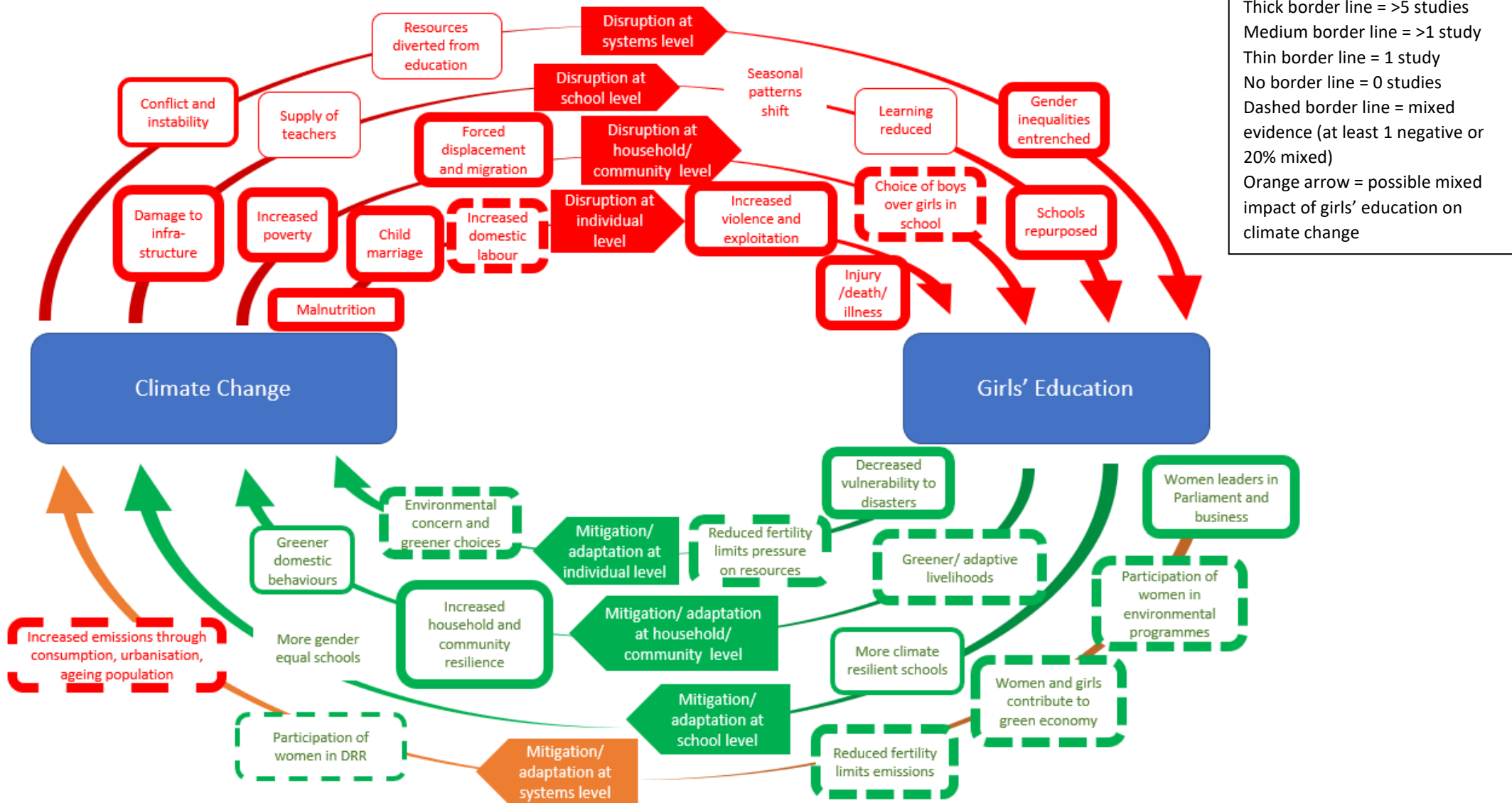
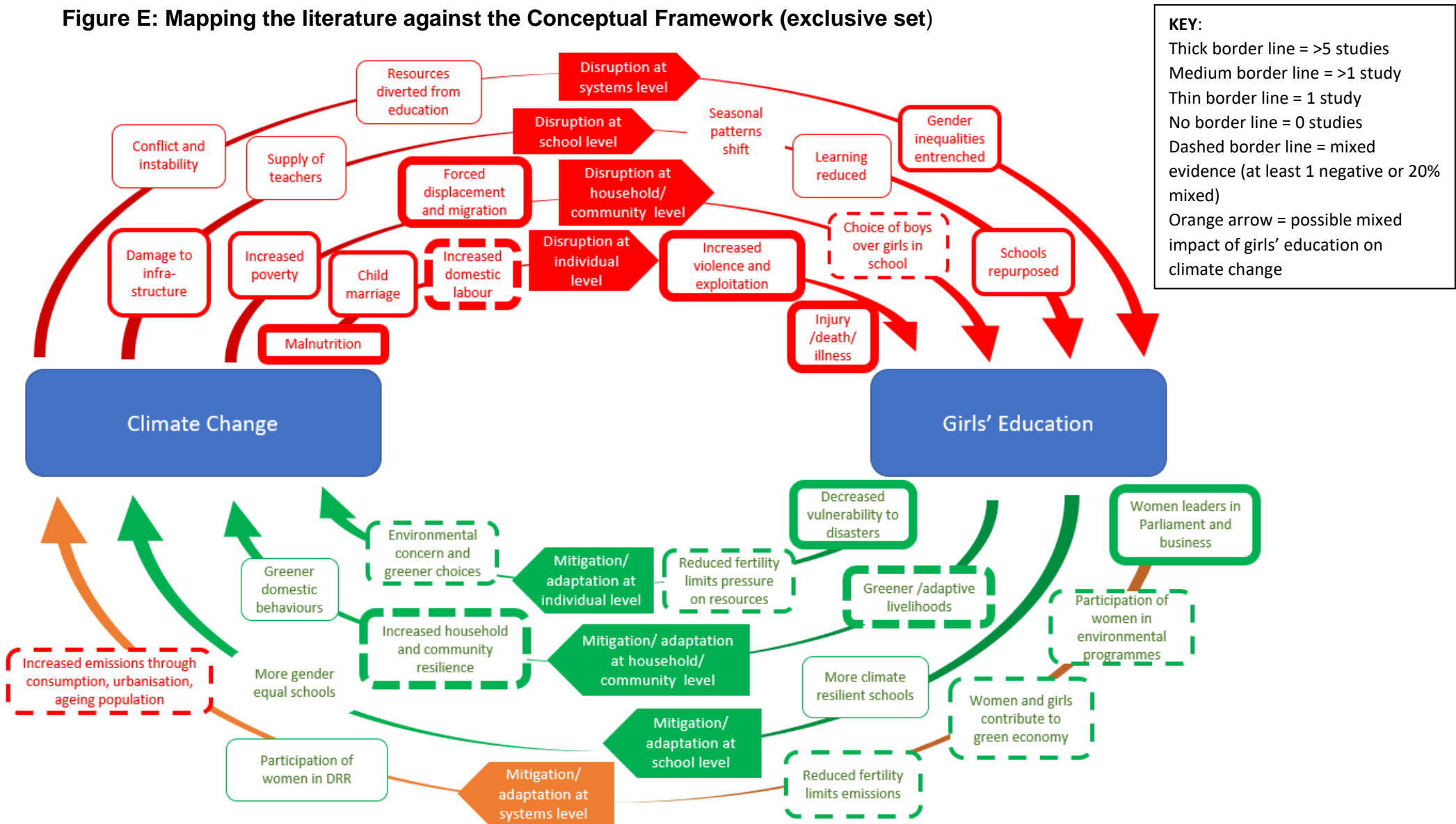


Figure E: Mapping the literature against the Conceptual Framework (exclusive set)



Presentation of key findings

The first headline finding is that there is evidence from LLMICs of the pathways between girls' education and climate change. However, this is nascent, with only 58 studies included that constitute high- or moderate-quality, primary and empirical or secondary evidence. The second headline finding is that the literature broadly supports the CF. However, this is not uniform. Some pathways and bubbles are better evidenced, whereas for others the evidence base is limited or inconsistent, particularly regarding the bottom half of the CF in the exclusive set of evidence.

This review therefore finds evidence of links between girls' education and climate change in LLMICs which demonstrates any binary conceptualisation of this relationship to be overly simplified. The relationships are in fact complex and context specific.

Impacts of climate change on girls' education

The review confirms that climate change has a negative impact on girls' education and wellbeing, with the strongest evidence at the individual level. Malnutrition; injury, illness or death; and increased violence and exploitation are strongly evidenced for both sets of studies. These impacts of climate change on girls are a source of unfreedom with life-altering and inter-generational effects, as demonstrated by Hyland and Russ's (2019) finding that children of drought-affected women were more likely to be born at low birth weight than those whose mothers had not experienced drought as children. Similarly, at household and community level the literature supports the CF, with forced displacement the strongest evidenced.

The findings on climate change's impact on domestic labour and choice of boys over girls in school are more nuanced than the dominant narrative suggests. Nordstrom and Cotton (2020) found that severe drought in Zimbabwe led to an increase in attendance from girls due to lower opportunity costs to education, but that learning decreased⁶. Mottaleb *et al.* (2015) found that the need to rebuild farms after cyclonic

⁶ They have no comparable data on boys.

disaster in Bangladesh increased the opportunity cost of *boys'* schooling with parents taking them out of school to work on reconstruction.

At the school level studies were less prevalent. However, the inclusive set of studies confirms the negative effect of climate change, particularly extreme weather events, on school infrastructure and schools being repurposed, suggesting these impacts affect access to education (Education Cannot Wait, 2020; Haneef and Tembe, 2019; Kousky, 2016; Sims, 2021; UNESCO, 2015). Only 1 study found evidence of a direct impact of climate change on learning (Nordstrom and Cotton, 2020).

At systems level, there was strong evidence that climate change entrenches gender inequalities through increasing violence, restricting economic opportunities, increasing familial and domestic burdens, and reducing human capital outcomes (Eastin, 2018; Langnel *et al.*, 2021; Masson *et al.*, 2019; McKinney and Fulkerson, 2015; Sims, 2021). 3 studies link climate change to conflict and instability (Atkinson and Bruce, 2015; Hsiang *et al.*, 2013; Opiyo *et al.*, 2014). Hsiang *et al.* (2013: 1)'s high quality synthesis of 60 experimental studies in over 40 conflict datasets finds that 'the magnitude of climate's influence on modern conflict is both substantial and highly statistically significant'.

Impacts of girls' education on climate change

The literature also broadly supports the bottom half of the CF. However, the exclusive set is lower in volume, with 31 'positive' studies in comparison to 42 for the top half, and more nuanced, with 16 'mixed' studies compared to only 2 for the top half. This requires careful unpacking.

The strongest evidence for the positive impact of girls' education is decreased individual vulnerability to disasters (Bangay, 2022; Feinstein and Mach, 2020; Muttarak and Lutz, 2014; Chowdury *et al.*, 2021; Sims, 2021; Send My Friend to School, 2021; Sperling and Winthrop, 2015; Streissnig *et al.*, 2013; UNDP, 2020). Streissnig *et al.* (2013)'s landmark empirical study of data from 125 countries from 1980-2010 identifies female education as the pre-eminent factor in reducing death from natural disasters. As elaborated by Muttarak and Lutz (2014):

‘Education can directly influence risk perception, skills and knowledge and indirectly reduce poverty, improve health and promote access to information and resources [...] educated individuals and societies are reported to have better preparedness and response to the disasters, suffered lower negative impacts, and are able to recover faster’.

Other bubbles at the individual level are more mixed. In the exclusive set, only 3 studies speak to the impact of education on environmental attitudes and behaviour. While Cleary and Rhead (2013) find a positive association between education and environmental attitudes, Komatsu and Rappleye (2018) and Saigal (2021) find a negative effect, which suggests that claims for this causal pathway need further investigation. Studies regarding girls’ education’s link to lower fertility and reduced pressure on (environmental) resources are similarly limited, with one positive (Price, 2020) and one mixed (Baker-Medard and Sasser, 2020) in the exclusive set. The evidence on links between education and reduced fertility are unpacked below. Assuming this link to be valid, the ‘common sense’ narrative that equates fertility to competition for resources is confirmed by the literature. However, as Baker-Medard and Sasser (2020) illustrate, the almost evangelical pursuit of population control to manage environmental degradation in Madagascar risks obscuring more influential drivers, such as the demands of commercial fishing and export, a colonial legacy of pronatalist policies, and complex marine property dynamics.

At the household and community level, there is strong evidence that women’s empowerment and participation improve resilience to extreme weather events and ill-effects of climate change with 9 studies pointing to this in the exclusive set (Austin and McKinney, 2016; Azong *et al.*, 2018; Batool *et al.*, 2018; Forbes-Genade and van Niekerk, 2017; Matewos, 2019; Muttarak and Lutz, 2014; Padmaja *et al.*, 2020; Samir, 2013; Sperling and Winthrop, 2015). 2 studies (Grillos, 2018; Mcleod *et al.*, 2018) are more nuanced, identifying barriers that prevent women from influencing decisions.

The findings regarding women’s participation and the adoption of greener or more adaptive livelihoods were mixed. In the exclusive set, several found evidence that women’s participation led to greener livelihoods (Aryal, 2020; Debesai, 2020; Vincent *et al.*, 2014) but other studies found that women were less likely to adopt sustainable

practices than men (Anik *et al.*, 2021; Assan *et al.*, 2018; Call and Sellers, 2019; Khoza *et al.*, 2019; Meinzen-Dick *et al.*, 2014).

There were surprisingly few studies on the relationship between girls' education and greener domestic behaviours and only 1 study in the exclusive set addressed the school level pathway (Forbes-Genade and van Niekerk, 2017).

The strongest evidence at systems level of the impacts of girls' education on climate change is related to women's political empowerment, with 6 studies in the exclusive set finding evidence of a positive link (Ergas and York, 2012; Ergas *et al.*, 2021; Lv and Deng, 2019; Mavisakalyan and Tarverdi, 2019; McGee *et al.*, 2020; McKinney and Fulkerson, 2015). 1 study identifies the role of a country's income threshold in determining whether women influence environmental action (Lv *et al.*, 2020). This has implications for LLMICs, as the authors conclude that 'only in high-income countries will the proportion of female parliaments significantly improve the country's environmental performance' (*ibid.*: 21273).

For the remaining bubbles on this pathway the evidence is limited and mixed, particularly in the exclusive group. While 1 study found that gender quotas improved environmental programmes' effectiveness (Cook *et al.*, 2019), 3 called this into question, identifying factors outside of gender that impacted participation and effectiveness (Call and Sellers, 2019; Meinzen-Dick *et al.*, 2014; Nhem and Lee, 2019).

The review's findings on women's participation in the green economy are interesting. In the inclusive set of studies 9 speak to this, with most in support of the CF (Afolabi *et al.*, 2017; Kwauk and Braga, 2017; Kwauk and Casey, 2021; Lutz and Streissnig, 2015; Sims, 2021; UNICEF, 2020). However, in the exclusive set only 1 study remains, which finds positive environmental impact from women's participation in the construction sector in Nigeria (Afolabi *et al.*, 2017). Given the dominance of 'green growth' in the evolving human development narrative it is unsurprising that this features in the literature. However, the lack of empirical evidence to suggest that this has a positive impact is noteworthy.

The impact of girls' education on reduced CO2 emissions through reduced fertility is considered in 8 studies in the inclusive set, the majority of which have mixed findings. In the inclusive set only 3 remain, all with mixed findings. There are two

dimensions to this mixed picture. First, is the link between girls' education and reduced fertility. Most of the literature assumes a link between education and reduced fertility, and this is built into climate projection models (Price, 2020). However, Psaki *et al.*'s (2019: 1) systematic review found limited and inconsistent evidence of a relationship, aside from 'small effects of increased grade attainment on lower fertility'. This suggests further research is needed to unpack the relationship between education and fertility, and to determine other influential factors. Second, is the link between reduced fertility and climate change. Studies acknowledge that fewer people mean less emissions, but the low relative and absolute emissions of populations in Africa is highlighted, 'making policies around fertility reduction unlikely to be a promising use of scarce political capital and policy attention' (Price, 2020: 2). When undertaking the review, it became evident that a further bubble was needed on the systems pathway; namely that girls' education could lead to *increased* emissions through increased consumption, urbanisation, and an ageing population, and thus could have a negative impact on climate change (Komatsu and Rappleye, 2018; Kwauk, 2020; Lutz and Streissnig, 2015; Price, 2020; UNDP, 2020).

Discussion and implications

Gaps in the evidence base

The review highlights that the evidence base is nascent and exposes important gaps, particularly in relation to the impacts of girls' education on climate change. It is striking how few studies in the exclusive set spoke to the school level. This suggests an imbalance in which sectors are conducting research into this relationship. Only 1 primary and empirical study was published in an education-specific journal, whereas 26 were published in environmental or disaster focussed journals, which are arguably less likely to consider impacts of climate change on education. This should be an area of focus for education and inter-disciplinary research, particularly because as climate change worsens the impacts on schools and access to education will intensify (Chigwanda, 2016; Devonald *et al*, 2021b).

Studies rarely identified a causal link for the whole pathway from girls' education to a positive impact on climate change. For instance, studies which spoke to the positive

impact of women’s participation in household and community decision making, disaster risk reduction, environmental programmes, or greener and more adaptive livelihoods did not necessarily relate this to their education. Further research would benefit from identifying causal pathways from start to finish and other contributing factors.

At this systems level, empirical evidence was limited and mixed, apart from women’s political empowerment. Participation of women in disaster risk reduction (DRR) and the green economy had only 1 study each, both pertaining to specific country contexts and thus not generalisable. Remaining bubbles had markedly mixed evidence, with mostly inconclusive findings. Further research is therefore needed to provide an empirical basis for this pathway. Given the time lag between intervention and impact, longitudinal data will be required.

Finally, there are gaps in geographic spread of the evidence. This is significant as the influence of context is evident across the CF. In some cases, empirical findings from specific countries call into question the dominant narrative in theoretical and conceptual studies, weakening commonly held assumptions. Further primary research in diverse contexts, particularly LICs, is therefore needed to build a better empirical understanding.

Evidence versus assumptions and assertions

Delineating the inclusive and exclusive sets of evidence proved illuminating, and highlighted the difference between assumptions, assertions, and reliable evidence. I provide two examples here.

First, 10 studies in the inclusive set spoke to the relationship between education and increased environmental concern and behaviours, with 6 citing a positive effect. ‘Climate change education⁷’ has been prioritised by activists working in the education/climate nexus (Earth Day, 2021; Kwauk and Winthrop, 2021) and is a major focus for UNESCO’s work on education and climate change (UNESCO, 2021). Perhaps because of this, at COP26 the first ever Education and Environment Ministers’ Summit saw a commitment to ‘the integration of sustainability and climate

⁷ <https://en.unesco.org/themes/education-sustainable-development/cce>

change in formal education systems, including as core curriculum components, in guidelines, teacher training, examination standards and at multiple levels through institutions' (UKCOP26, 2021).

However, in the exclusive set only 3 studies remained, of which 2 had mixed findings, indicating that this focus is not well-evidenced. Indeed, as Bangay (2022) notes, previous evidence from health education campaigns demonstrates that the link between increased knowledge and changed behaviours is weak. And as stated by Devonald *et al.* (2021a, emphasis added) 'increased girls' education is *positively* correlated with emissions, and the high-income countries with higher levels of female education emit more carbon than average'. Clearly the relationship between education and improved environmental outcomes requires more attention.

Second, some studies in the inclusive set claimed relationships between girls' education and climate change that may not withstand scrutiny. Kwauk and Braga (2017: 19) identify a strong positive correlation between the average years of girls' schooling and a country's score on the ND-GAIN index⁸. They extrapolate that:

'For every additional year of schooling for girls on average, a country's ND-GAIN score could be expected to increase by 3.2 points ($p < .001$), notwithstanding other potential control variables unaccounted for'.

However, these 'other potential control' variables could be many, and arguably more influential than girls' education. Girls are more likely to be better educated in high income countries, where vulnerability to climate change is low compared to low-income countries. The defining factor could therefore be income level, or geography, given that low-income countries are more commonly situated in regions most affected by climate change. Furthermore, years of schooling alone is arguably unlikely to be the defining factor divorced, for instance, from the quality of environmental or sustainability content in the curriculum.

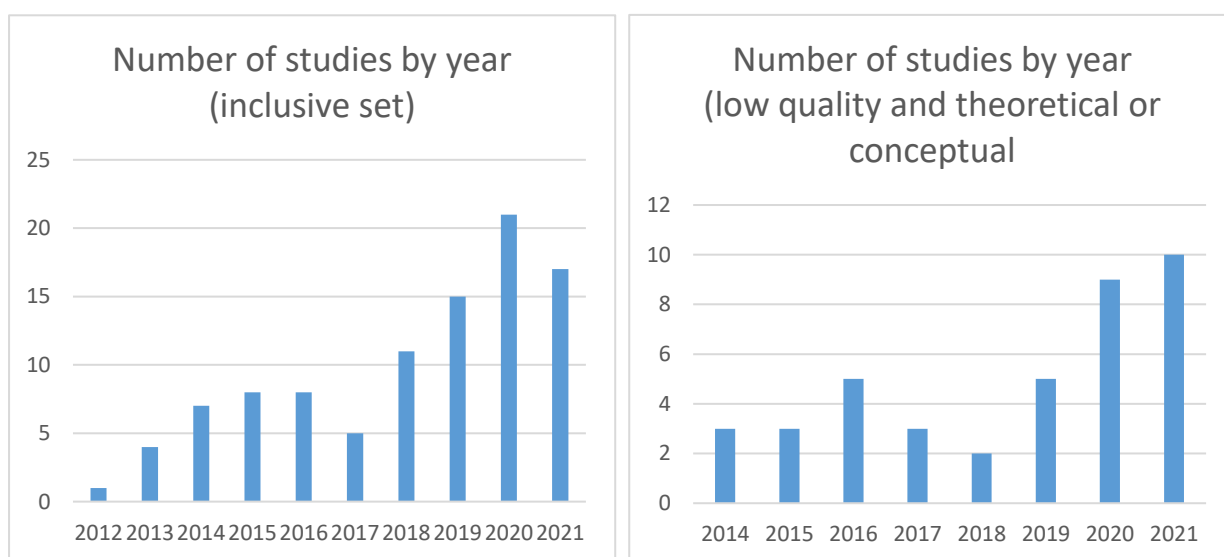
Several other studies in the inclusive set cite Kwauk and Braga's finding, without outlining the assumptions (Kwauk, 2020; Malala Fund, 2021a; Send My Friend to School, 2021; Sims, 2021). Such an approach risks creating a methodological echo

⁸ The ND-GAIN Country Index measures countries' vulnerability to climate change relative to readiness to improve resilience. Higher scores represent lower vulnerability (Kwauk and Braga, 2017).

chamber whereby theorised relationships between girls’ education and climate change are legitimised as evidence by repetition, which could obscure other important factors.

The balance between evidence and assertions is particularly important because the focus on girls’ education in the context of climate change is growing. The two graphs below demonstrate this, with the first showing the number of included studies per year, and the second showing only those which are excluded from the exclusive set. This second group includes most of the grey literature, including reports and recommendations aimed at decision makers. It is outside the scope of this review to determine the influence of such literature, and I by no means intend to suggest that girls’ education should not be prioritised, or that teaching about climate change is not a good thing to do. I just highlight that in a context of scarce resources and scarce time to combat the climate emergency, it is imperative that where possible evidence, and not assumptions, guides interventions.

Figure F: Number of studies by year



Instrumental versus intrinsic value of education

By focussing on the potential positive outcomes of girls’ education for combatting climate change, girls’ education is inherently positioned as an instrumental good. This is in line with the dominant Human Capital conceptualisation which has driven prioritisation of girls’ education since the 1960s (Unterhalter, 2016). Peppin Vaughan (2019) charts the development of ‘girls’ education’ as an agenda and argued that it represents a particular form of gender equality in education which is preoccupied

largely with gender parity in access and learning outcomes. Peppin Vaughan suggests that in becoming the dominant conceptualisation, ‘girls’ education’ has limited space for a broader agenda that pays attention to inequalities within education (such as curricula and pedagogy) and wider society (*ibid.*).

However, the instrumental potential of girls’ education to combat climate change outlined in the CF is currently unlikely to be realised, particularly in LLMICs. Here I briefly outline why.

Perhaps most fundamentally, if girls do not master basic skills of literacy and numeracy, the foundational nature of education heralded by the CA cannot be realised and all other positive causal pathways will be undermined. Even before COVID-19, 53% of children in low- and middle-income countries were in ‘learning poverty’ and the World Bank (2021c) has estimated that this could rise to 70% due to prolonged school closures and associated impacts. Addressing this learning crisis is therefore of paramount importance.

Most, if not all, of the potential benefits of girls’ education for addressing climate change at the systems level require secondary level schooling. However, the UNESCO Institute of Statistics (2019) estimates that for 59 million children of primary school age out of school, there are 62 million at lower secondary age, and 138 million at upper secondary age.

If curricula contain insufficient focus on developing critical thinking, STEM, climate change or DRR, girls will neither be inspired to care about the planet or equipped with the knowledge and skills they need to participate in addressing climate change. However, as Kwauk (2020: 14) outlines, a study of 1,480 secondary school textbooks from 98 countries revealed that less than half included content on the SDG Target 4.7 issues. Kwauk’s (2021: 3) study of countries’ Nationally Determined Contributions⁹ (NDCs) found that ‘only a few countries have outlined their plans to include mandatory climate education curricula into formal education systems’.

Included studies highlight that the type of education girls receive matters, and while education’s potential to disrupt climate change has been heralded, Kwauk (2020)

⁹ National climate action plans for reducing greenhouse gas emissions and adapting to climate change

argues that currently the education sector is complicit in the perpetuation of the climate change status quo. Komatsu and Rappleye (2018: 3) agree, finding that ‘promotion of education based on the current paradigm can have negative impacts on the achievement of other SDGs related to the environment’, and positing that Western culture of individualism is part of the problem, and that expansion of Western education could increase climate change (*ibid.*). McLeod *et al.* (2018) raise concern about expansion of Western education into indigenous communities, finding that in Pacific Islands, younger generations’ Western education risks displacing traditional knowledge which has enabled adaptation to climate change over centuries. Thus, uncritical continuation of the neo-liberal norm could do more harm to the planet than good.

If broader efforts to achieve gender equality do not accelerate, then girls will still have little choice but to operate in the restricted (domestic) space allocated to them by men. If family planning services are not available, then the national family size in LLMICs will continue to be larger than reported preference (Quak, 2020). If schools are not resilient to weather shocks, then education will continue to be disrupted with negative knock-on effects for any benefits (Chigwanda, 2016). And if sufficient financial, human, and technical resources are not available to schools, then positive outcomes can hardly be expected. UNESCO’s (2020b) estimation of an annual aid reduction for education of \$2 billion in the wake of COVID-19 thus poses huge cause for concern.

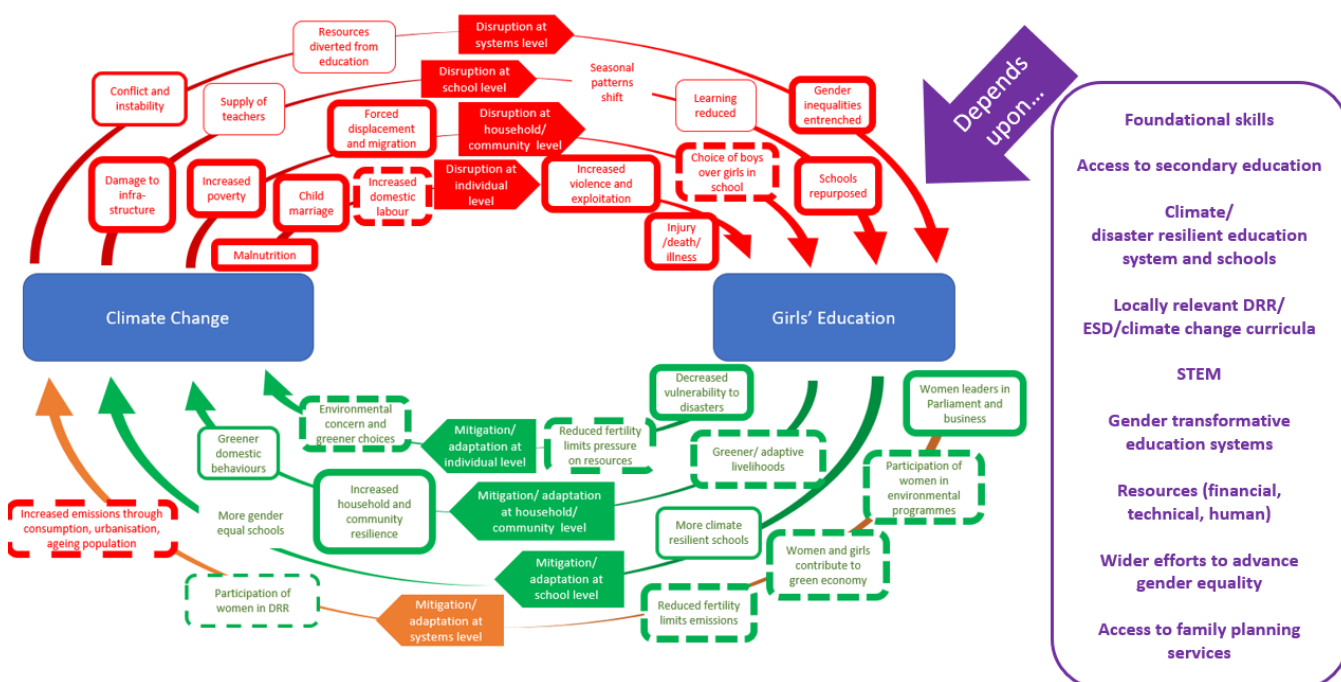
Somewhat ironically, therefore, focussing on the instrumental benefits of girls’ education risks obscuring critical considerations about the intrinsic quality/ies of girls’ education needed for it to effect climate change. This suggests that a much deeper engagement is needed with these quality/ies of education. Furthermore, as Bangay (2022) has argued, it is important not to view education in a silo. Rather, it is the interaction of education with sexual and reproductive health rights, women’s legal and economic empowerment, early childhood development and more that will lead to transformative change.

Here, the Capability Approach’s focus on the intrinsic quality/ies of education comes to the fore. Arguably, it is only by prioritising these qualities, and viewing the purpose of education as expanding capabilities for girls (and boys) to live fulfilled – and in this

context sustainable – lives, that any positive benefits can be gained for children, their communities, or indeed the planet.

Figure G (purple box) suggests an initial list of factors that the positive impacts of girls’ education on climate change could depend upon, drawing on frameworks developed by Kwauk *et al.* (2019), Kwauk (2020), Kwauk and Braga (2017), Kwauk and Casey (2021) and Malala Fund (2021a). However, this is not exhaustive or well-evidenced. Future research would benefit from determining what quality/ies of education girls need to live sustainable lives they value and that provides them with the skills, knowledge and opportunity to positively affect the world around them.

Figure G: Qualities of education required for positive impact



Furthermore, instrumentalist approaches can divert attention from the fact that education is a universal human right, a right denied to hundreds of millions of children. Pre-COVID-19 258 million children were out of school – half of them girls – and at the end of 2021 some education systems in LLMICs remained fully closed, or only partially open¹⁰. As outlined in the Global Education Evidence Advisory Panel’s

¹⁰ At the time of writing in January 2022, approximately 635 million children’s education was still disrupted: [UN data reveals ‘nearly insurmountable’ scale of lost schooling due to Covid | Global development | The Guardian](#)

(2022: 9) special report on COVID-19, 'while school closures hurt all students, the costs are highest for already disadvantaged groups including poor students, and adolescent girls face particular challenges'. Some estimates suggest that 20 million girls will never return to their classrooms (Malala Fund, 2021c) and as set out above, COVID-19 has severely compounded the learning crisis. It is thus critically important that focussing on the benefits of girls' education for other purposes, including addressing climate change, does not detract from the intrinsic importance of education itself.

Implications

There are several implications for research, policy and practice identified through this review. First, is the urgency with which action needs to be taken. The review has shown that climate change is already having a detrimental impact on girls' (and boys') education, and that these negative effects are likely to accelerate, with the potential to reverse gains made in reducing poverty and inequality and expanding freedoms. There is an enormous moral imperative to prevent this and priority must be given to building the resilience of education systems. This includes 'climate proofing' schools, securing equitable provision of distance learning, and scaling up emergency education to respond to extreme weather events and displacements.

The review identifies that girls' education holds huge potential in terms of both adapting to, and mitigating against, climate change. Ensuring every child's fundamental right to an education that provides them with the foundational skills they need to survive and thrive is realised is of paramount and urgent importance.

Action must be underpinned by research. This review has demonstrated that many bubbles and pathways in the CF lack rigorous evidence or have mixed findings depending on context. This is particularly true for the bottom half of the CF. There is an urgent need to ramp up research to start filling some of the gaps in the pathways and answer important questions about what works to adapt to and mitigate climate change, particularly in terms of systemic education reform. Further context-specific evidence is needed to better understand how the relationship between girls' education and climate change is localised in different situations and for different

groups to avoid policies and practice which assume universal experiences of climate change for all girls and women. Research should be conducted from a broader range of disciplines, particularly those working in education, to better understand the relationship at the school level.

It is important to say a word about resources, as the costs (human and financial) of adapting to changing climates are rising, particularly for LLMICs. The financing gap for adaptation has been estimated at \$30 billion annually (United Nations Environment Programme, 2021). Within that context, financing for education lags far behind climate finance (Kharas, 2016). The deep links between the climate and learning crises, suggest the benefits of viewing (girls') education through the prism of climate change resilience, adaptation and mitigation intervention. Such an approach could present a 'win-win' for both human freedoms and planetary protection.

Conclusion

This report is, to the best of my knowledge, the first rigorous review that investigates the relationship between girls' education and climate change in LLMICs. I offer a CF against which I reviewed and mapped the literature in answer to the question '*what evidence is there of the relationship between girls' education and climate change in LLMICs?*'. I find that evidence is limited in scale and depth and mixed in findings. By assessing the quality of studies, I illuminate the difference between the broad literature and a more discerning evidence base. This exposed gaps in the evidence base for widely assumed and asserted causal links between girls' education and climate change.

I have identified implications for future research, policy, and practice. There is a clear, and urgent need for high quality primary research that deepens and widens understanding of the connections between girls' education and climate change in diverse contexts. Currently, policy and practice are poorly evidenced and risk being built on assumptions, which could affect effectiveness.

To come back to the question as to whether girls' education is indeed 'the silver bullet' to address climate change, the answer is of course, 'no'. Or perhaps better to

say, 'not alone'. This review has shown that some benefits of girls' education are evident and evidenced: Education's role in reducing vulnerability to disasters and improving resilience and adaptability, for instance, is clear. Other elements are promising but not yet robustly evidenced, meaning we cannot say with certainty that the positive paths in the conceptual framework will be realised. I have suggested that whether they are realised depends partly on the quality of education. This, coupled with the moral imperative to ensure quality education for every child in the face of the learning, COVID-19, and climate crises, highlights the pitfalls of taking an instrumentalist approach and recommends the CA as a sound theoretical framing for future efforts.

Furthermore, even if all the potential outcomes for girls' education on climate change set out in the CF were realised in full, it could not alone save the world. Climate change and associated environmental degradation are the result of complex interacting systems and processes which have developed over the course of centuries (IPCC, 2021). Failure to keep these macro factors and responsibilities in view risks placing too heavy a burden on the shoulders of women and girls in LLMICs, for whom most of the drivers of climate change are out of reach. It also risks letting those who hold ultimate responsibility off the hook, as for there to be any hope of reducing the rate of climate change, meaningful, urgent action must be led by governments (UNDP, 2020). Some argue that the dominant economic development model itself needs to shift, to find a way to sustain life within our means (Raworth, 2017). As set out in the Human Development Report (UNDP, 2020: 9), 'business as usual simply will not work' and time is fast running out to prevent accelerating disastrous impacts for climate-vulnerable communities worldwide.

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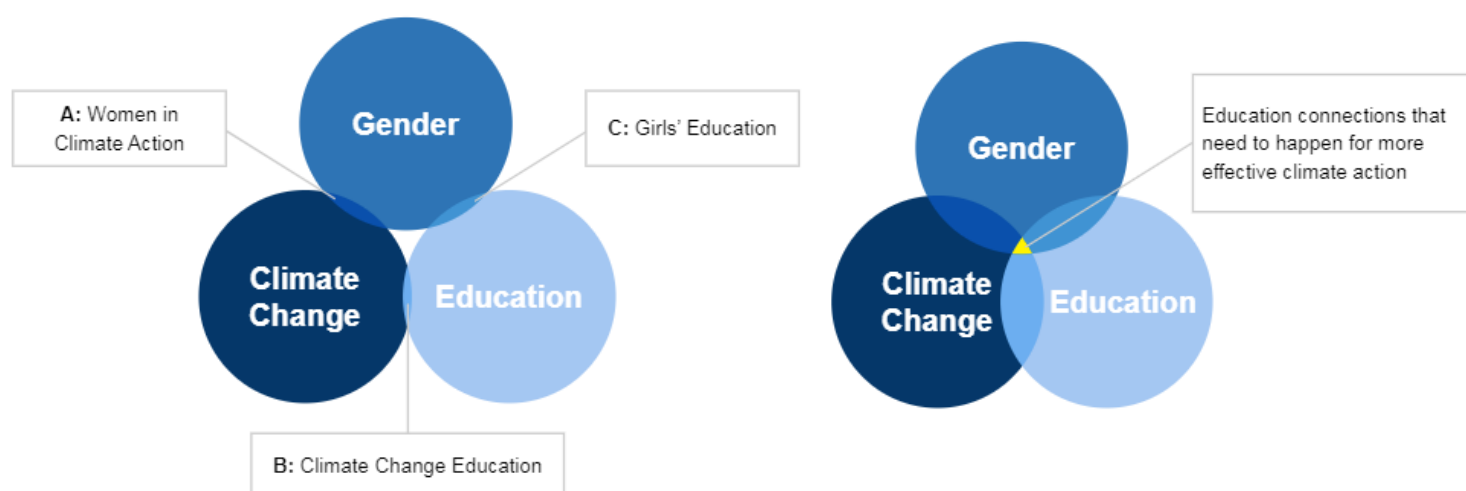
Appendices

Appendix A – Existing conceptual frameworks on (girls’) education and climate change

Several conceptual frameworks outlining elements of the relationship between girls’ education and climate change exist. Here I briefly summarise them.

Figure i (Kwauk and Braga, 2017) conceptualises current high-level approaches to integrating action on gender, education and climate change against their proposed more integrated approach for more effective climate action. These conceptual frameworks position three relevant sectors in relation to each other and signal potential for synergy at points of overlap. However, they do not say anything about the nature of these connections or the direction of causes and effects.

Figures i: Kwauk and Braga (2017)



Muttarak and Lutz (2014) developed a flow chart (Figure ii) which outlines the relationship between education and vulnerability reduction through both direct and indirect effects. Chigwanda (2016) built upon this to offer Figure iii, which speaks more directly to the relationship between education and resilience in the face of crises, particularly droughts. Taken together, Figures ii and iii helpfully unpack some of the factors at play within the green arrow in Figure A. However, they focus primarily on individual resilience. This fails to consider both the wider social and

systemic relationships between girls’ education and climate change or role girls’ education could play in climate change mitigation and adaptation.

Figure ii: Lutz *et al.* (2014)

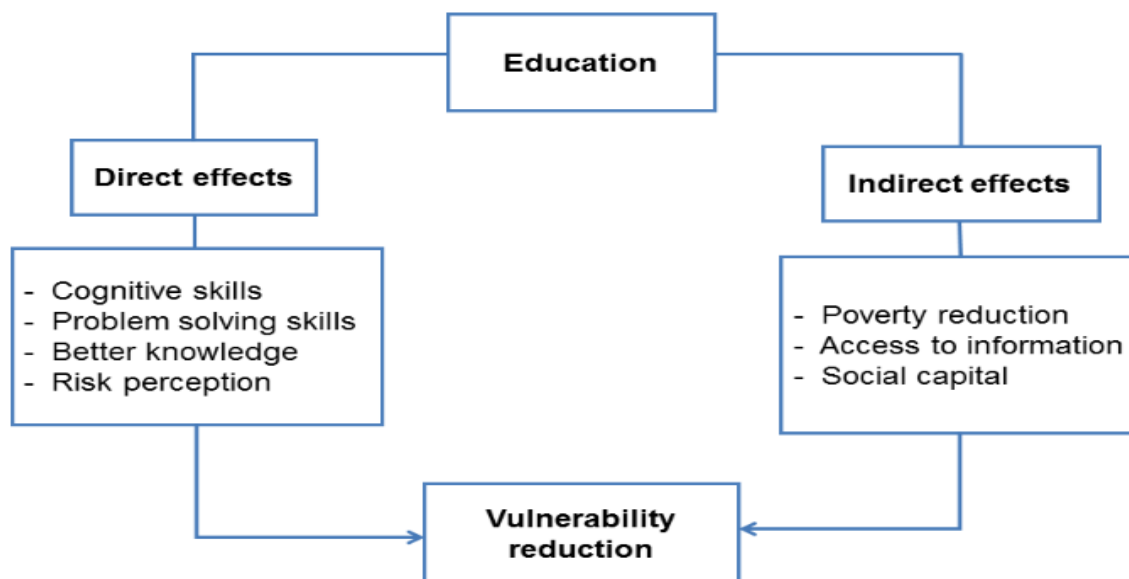


Figure iii: Chigwanda (2016)

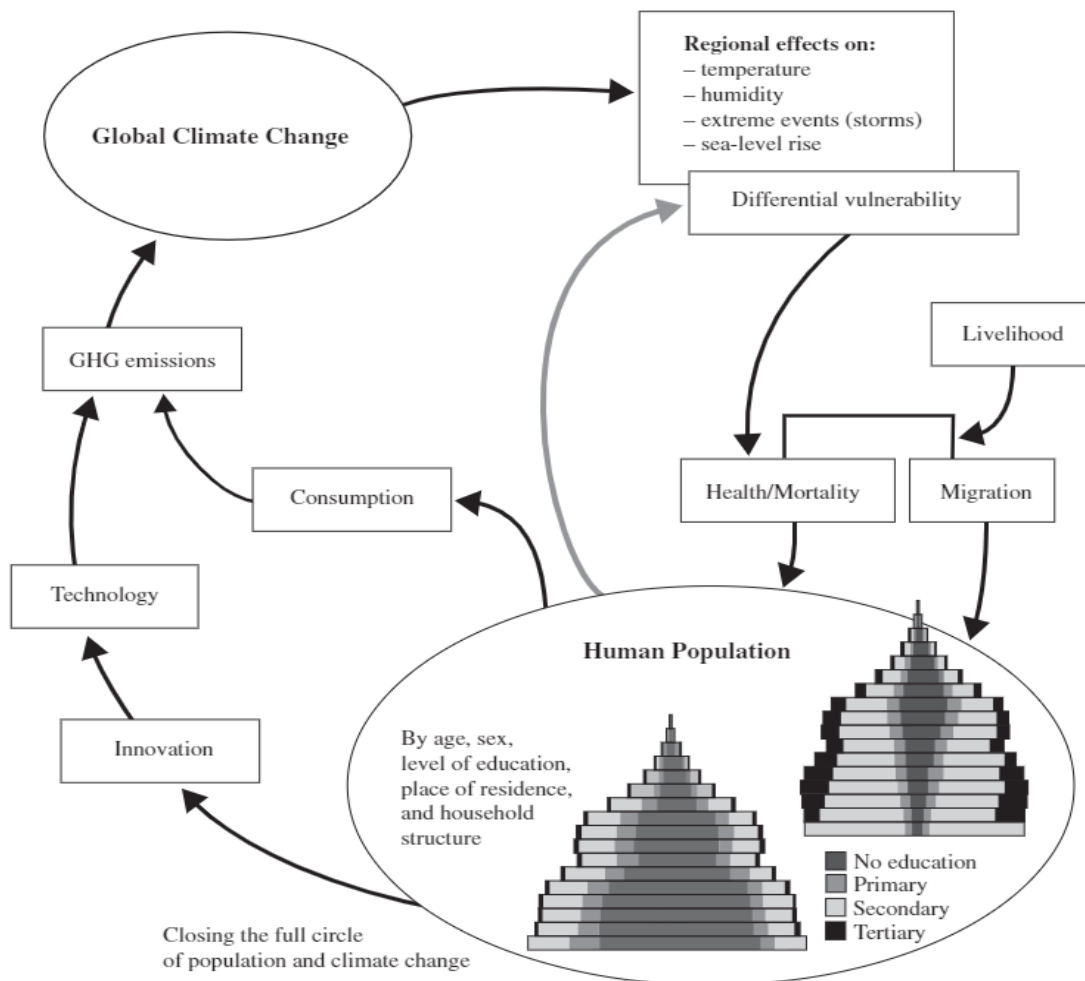


Various frameworks exist to unpack the relationship between population and climate change. See, for example, Figure iv below taken from Lutz and Streissnig (2015). Given the centrality in the literature placed upon girls’ education’s role in curtailing

population growth to mitigate climate change, this CF is important. It highlights the over-simplification of an assumed causal link between population and climate outright by mapping diverse and seemingly contradictory ways in which population and climate change intersect and signalling the influence of specific factors of human population, such as education. This speaks to the importance of the capabilities of the human population, beyond its quantum, in determining climate change mitigation and adaptation. For instance, if the human population is better educated, to a higher level, vulnerability is likely to be lower due to better health and livelihoods, and innovation greater – perhaps leading to positive climate impacts.

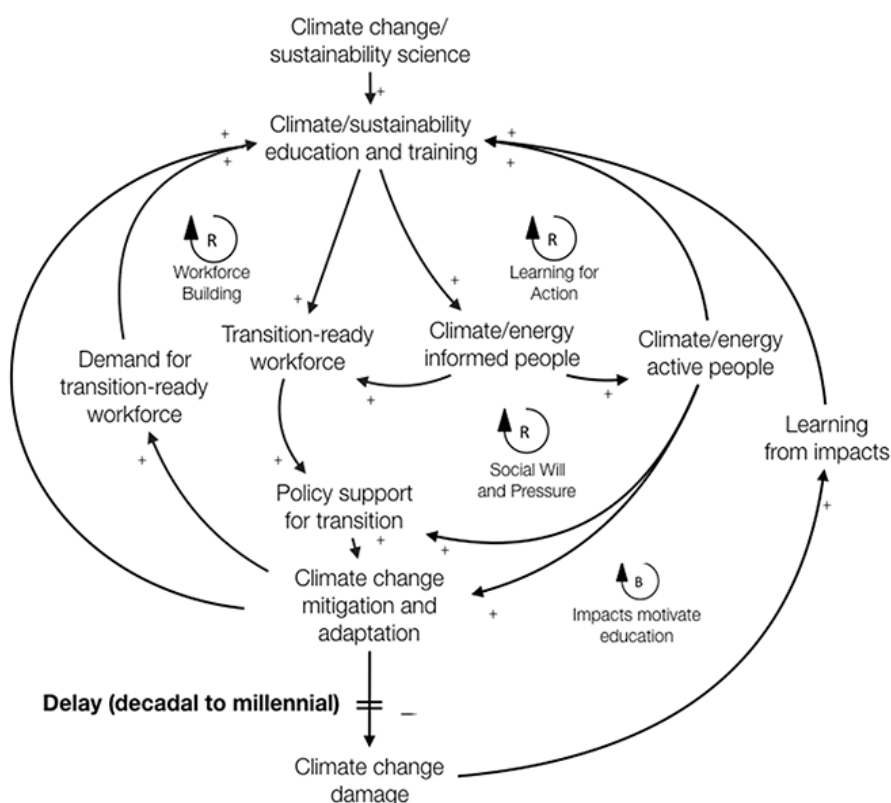
However, in unpacking the connections between population and climate change this CF addresses only one – albeit important – element of my research question.

Figure iv: Lutz and Streissnig (2015)



Ledley *et al.*, (2017) take a systems-thinking approach to examine education’s potential to drive social change in addressing climate change. They depict the role education could play in processes that could accelerate climate change mitigation. This unpacks the fact that education is ‘critical for science and technology based changes in individual behaviour, workforce development and training, policy support, and policy- and decision-making’. However, it is largely focussed on developed contexts – particularly the United States –, addresses only a limited element of the relationship and (similar to several examples above) does not consider gender.

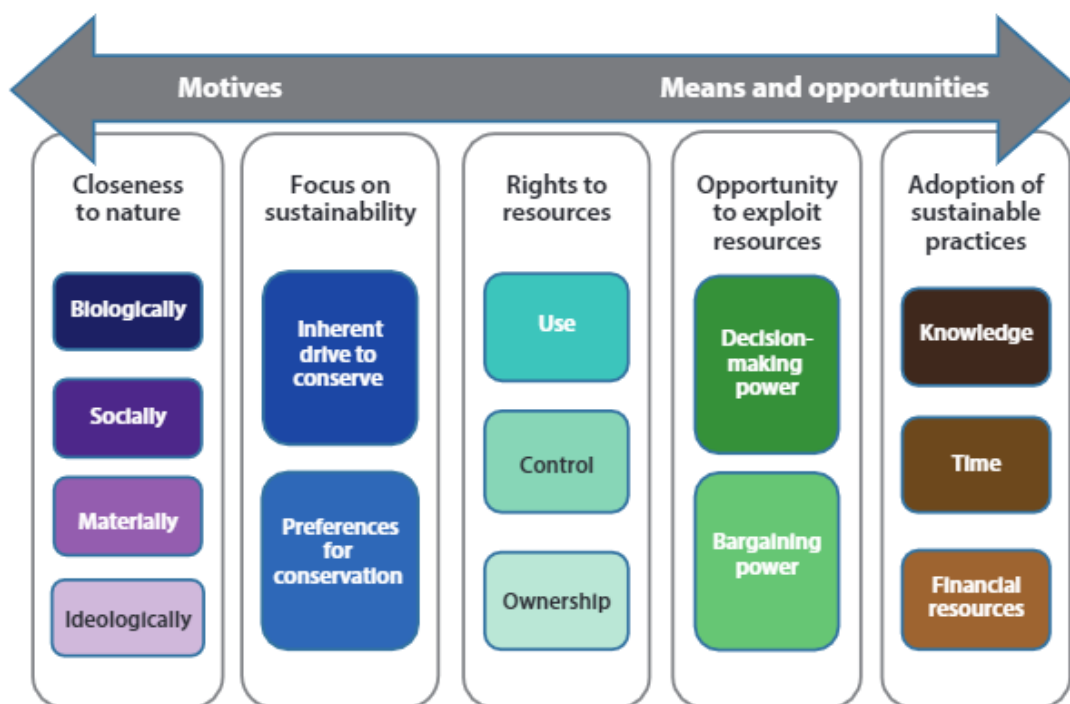
Figure v: Ledley *et al.* (2017)



Meinzen-Dick *et al.* (2014: 29) explore how ‘gender shapes the motives, means, and opportunities for men and women to contribute to sustainability’. Their framework maps different factors that influence this, demonstrating that there are a wide variety from motives through to means and opportunities for women and girls (and men and boys) to engage with sustainability. This framework helpfully illustrates the diversity of women and girls and differential desire and ability to impact upon climate change.

However, it is predominantly focussed on natural resource management and thus speaks to a relatively small part of the relationship.

Figure vi: Meinzen-Dick *et al.*, (2014)



Appendix B – Detailed methodology

Pillar 2: Detailed approach

Finalising the search terms required careful attention. The research question was broken down into key concepts: girls' education, climate change and geography. First, an expansive approach was taken (see below). The concepts were broken down into lists of keywords. To ensure literature that did not use the terminology of 'girls' education' was not excluded, these concepts were separated using the Boolean operator 'AND' and expanded using 'OR'. 'Climate change' required expansion to capture literature that ranged from general evidence on risk, resilience, adaptation and mitigation, to specific manifestations such as droughts or floods, to technical terms such as carbon abatement. 'Natural disaster' was included as evidence suggests climate change is increasing the frequency and severity of disasters. The concept of 'geography' was expanded to include a list of low and lower-middle income countries (LLMICs) according to the World Bank's 2021 categorisation as well as terms such as 'developing country' and 'global'.

This expansive approach returned a high number of irrelevant results. The separation of 'girl' and 'education' meant that many results said nothing meaningful about the research question. More concerning, important studies were missing. This was largely due to the geography concept because many studies do not specify a geographic focus in the title, abstract or keyword. However, removing the geography concept led to results upwards of 4000 studies, which breached what it was possible to screen within the confines of the report.

A targeted approach was developed (see below). The geography concept was removed from the search string and handled through the screening process. 'Girl' and 'education' were recombined and commonly cited outcomes of girls' education of empowerment, leadership, and participation included.

Table i: Pillar 2 expansive approach search strategy

First concept (OR)		Second concept		Third concept (OR)		Geography (OR)
Girl*	AND	Educat*	AND	Climate change ¹¹	AND	Developing countr*
Female		School*		Climate risk		Low income countr*
Women		Leader*		Climate vulnerability		Lower middle income countr*
		Empower*		Climate adaptation		Global
				Climate resilience		Worldwide
				Climate crisis		Universal
				Disaster risk		Africa
				Disaster preparedness		Countries according to WB 2020
				Carbon emission*		
				Carbon abatement		
				Mitigation and adaptation		
				Climate action		
				Environmental degradation		
				Global warming		
				Greenhouse gases		
				Natural disaster		
		Flood*				
		Drought				
		Desertification				
		Rising sea level				

Table ii: Pillar 2 targeted approach search strategy (final approach)

¹¹ The colour coding of this column signifies the order in which terms were added as I expanded the search strings to capture as many relevant results as possible: 1. Purple, 2. Green, 3. Blue, 4. Orange. 5. As well as synonyms and examples of specific climate change phenomena, additional terms were taken from relevant papers to make sure they would be included in the results (eg carbon emissions and carbon abatement). This was important because the literature is from a range of disciplines (medical, education, social science, environmental science etc.) and the terminology used is different.

First concept (OR)		Second concept (OR)
Girl* education	AND	Climate change
Female education		Climate risk
Women* education		Climate vulnerability
Female school*		Climate adaptation
Girl* school*		Climate resilience
Female leader*		Climate crisis
Girl leader*		Disaster risk
Women leader*		Disaster preparedness
Female empower*		Carbon emission*
Girl* empower*		Carbon abatement
Women* empower*		Mitigation and adaptation
Female participat*		Climate action
Girl* participat*		Environmental degradation
Women* participat*		Global warming
		Greenhouse gases
		Natural disaster
	Flood*	
	Drought	
	Desertification	
	Rising sea level	

Pillar 3: Websites searched

- UK Foreign Commonwealth and Development Office
- World Bank
- UNESCODO
- Brookings Institution
- UNDP

Table iii: Main codes used to map and analyse evidence

Main code	Child code 1 st level	Child code 2 nd level	Child code 3 rd level	Notes
Search strategy	Pillar 1			To disaggregate what info came from which search pillar
	Pillar 2			
	Pillar 3			
Contextual focus	Country or region			As per World Bank (2021b)
Conceptual focus	8 pathways from CF	Bubbles in CF	Positive	
			Negative	
			Mixed	
Method	Primary and empirical	Observational designs		Typology taken from BE2 (2020)
		Quasi-experimental		
		Experimental designs		
	Secondary	Systematic review		
		Rigorous review		
		Non-systematic review		
	Theoretical or conceptual			
Quality	High			Using BE2 (2020) criteria: conceptual framing, openness and transparency, robustness of methodology, cultural appropriateness/sensitivity, validity, reliability and cogency to grade quality.
	Moderate			
	Low			
	N/A			

Appendix C – Overview of studies included¹²

	Citation	Country/region	Type of study	Conceptual pathway(s)	Bubble(s)
Exclusive set					
1	Afolabi <i>et al.</i> (2017)	Nigeria	Primary and empirical	Adaptation/mitigation at systems level	Women contribute to the green economy (P)
2	Alston <i>et al.</i> (2014)	Bangladesh	Primary and empirical	Disruption at individual level Disruption at household/community level	Choice of boys over girls in school (P) Increased violence and exploitation (P) Increased violence and exploitation (P)
	Anik, <i>et al.</i> (2021)	Bangladesh	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (N)
3	Aryal <i>et al.</i> (2020)	India	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (P)
4	Assan <i>et al.</i> (2018)	Ghana	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (M)
5	Austin and McKinney (2016)	Global (developing)	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P)
6	Azong <i>et al.</i> (2018)	Cameroon	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P)
7	Baker-Médard and Sasser (2020)	Madagascar	Primary and empirical	Adaptation/mitigation at individual level	Reduced fertility limits pressure on resources and environmental degradation (M)
8	Batool <i>et al.</i> (2018)	Pakistan	Primary and empirical	Disruption at household/community level Adaptation/mitigation at household or community level	Choice of boys over girls in school (P) Increased household and community preparedness and resilience (P)
9	Call and Sellers (2019)	Global (developing)	Secondary	Adaptation/mitigation at household or community level Adaptation/mitigation at systems level	Greener livelihood choices (M) Women's participation in environmental programmes increases their effectiveness (M)

¹² (P) = Positive; (N) = Negative; (M) = Mixed

10	Choudary <i>et al.</i> (2021)	India	Primary and empirical	Adaptation/mitigation at individual level	Decreased vulnerability to disasters (P)
11	Clery and Rhead (2013)	Global (developing)	Primary and empirical	Adaptation/mitigation at individual level	Increased environmental concern/greener life choices (P)
12	Cook <i>et al.</i> (2019)	Tanzania	Primary and empirical	Adaptation/mitigation at systems level	Women's participation in environmental programmes increases their effectiveness (P)
13	Debesai (2020)	Eritrea	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (P)
14	Eastin (2018)	Global (developing)	Primary and empirical	Disruption at systems level	Gender inequality entrenched (P)
15	Ergas and York (2012)	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (P)
	Ergas <i>et al.</i> (2021)	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (P)
16	Forbes-Genade and van Niekerk (2017)	Africa (where multiple countries)	Primary and empirical	Adaptation/mitigation at household or community level Adaptation/mitigation at school level	Increased household and community preparedness and resilience (P) More climate resilient schools (P)
17	Gebre <i>et al.</i> (2018)	Ethiopia	Primary and empirical	Disruption at individual level	Malnutrition (P)
18	Grace <i>et al.</i> (2015)	Africa (where multiple countries)	Primary and empirical	Disruption at individual level	Malnutrition (P)
19	Grillos (2018)	Kenya	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (M)
20	Hsiang <i>et al.</i> (2013)	Global (developing)	Secondary	Disruption at systems level	Conflict and instability (P)
21	Hyland and Russ (2019)	Africa (where multiple countries)	Primary and empirical	Disruption at household/community level Disruption at individual level	Increased poverty (P) Malnutrition (P) Injury/death/illness (P)

	Islam and Sharma	Bangladesh	Primary and empirical	Disruption at individual level	Increased domestic labour (P)
22	IDMC (2020a)	Global (developing)	Primary and empirical	Disruption at household/community level	Forced displacement/migration (P)
23	Khoza <i>et al.</i> (2019)	Africa (where multiple countries)	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (M)
24	Komatsu and Rappleye (2018)	Global (developing)	Primary and empirical	Adaptation/mitigation at individual level Adaptation/mitigation at systems level	Girls' education leads to increased emissions through consumption/urbanisation/aging population (P) Increased environmental concern/greener life choices (N)
25	Kousky (2016)	Global (developing)	Secondary	Disruption at systems level Disruption at individual level Disruption at school level	Resources diverted from education (P) Damage to infrastructure (P) Malnutrition (P) Increased domestic labour (M) Injury/death/illness (P)
26	Langnel <i>et al.</i> (2021)	Africa (where multiple countries)	Primary and empirical	Disruption at systems level	Gender inequality entrenched (P)
27	Le Masson <i>et al.</i> (2016)	Global (developing)	Secondary	Disruption at household/community level Disruption at individual level	Forced displacement/migration (P) Increased domestic labour (P) Child marriage (P)
28	Lv and Deng (2019)	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (P)
29	Lv <i>et al.</i> (2020)	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (M)
30	Masson <i>et al.</i> (2019)	Chad	Primary and empirical	Disruption at systems level Disruption at individual level	Gender inequality entrenched (P) Increased violence and exploitation (P)

31	Matewos (2019)	Ethiopia	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P)
32	Mavisakalyan and Tarverdi (2019)	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (P)
33	McGee <i>et al.</i> (2020)	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (P)
34	McKinney and Fulkerson (2015)	Global (developing)	Primary and empirical	Disruption at systems level Adaptation/mitigation at systems level	Gender inequality entrenched (P) Women's higher political and/or economic status associated with greener outcomes (P)
35	Mcleod <i>et al.</i> (2018)	Pacific Islands	Primary and empirical	Disruption at individual level Disruption at school level Disruption at household/community level Adaptation/mitigation at household or community level	Damage to infrastructure (P) Forced displacement/migration (P) Increased violence and exploitation (P) Increased household and community preparedness and resilience (M)
36	Meinzen-Dick <i>et al.</i> (2014)	Global (developing)	Secondary	Adaptation/mitigation at systems level Adaptation/mitigation at household or community level	Greener livelihood choices (M) Women's participation in environmental programmes increases their effectiveness (M)
37	Mottaleb <i>et al.</i> (2015)	Bangladesh	Primary and empirical	Disruption at household/community level	Choice of boys over girls in school (N)
38	Muttarak and Lutz (2014)	Global (developing)	Secondary	Adaptation/mitigation at individual level Adaptation/mitigation at household or community level	Decreased vulnerability to disasters (P) Increased household and community preparedness and resilience (P)
39	Nhem and Lee (2019)	Cambodia	Primary and empirical	Adaptation/mitigation at systems level	Women's participation in environmental programmes increases their effectiveness (M)
40	Nordstrom and Cotton (2020)	Zimbabwe	Primary and empirical	Disruption at individual level	Malnutrition (P) Increased domestic labour (N)
	Nzabona <i>et al.</i> (2021)	Uganda	Primary and empirical	Adaptation/mitigation at household or community level	Greener household behaviours (P)

41	Padmaja <i>et al.</i> (2020)	India	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P)
42	Patel <i>et al.</i> (2020)	Asia (where multiple countries)	Primary and empirical	Disruption at household/community level	Increased poverty (P)
43	Peek <i>et al.</i> (2018)	Global (developing)	Secondary	Disruption at household/community level Disruption at individual level	Increased poverty (P) Forced displacement/migration (P) Injury/death/illness (P)
44	Price (2020)	Africa (where multiple countries)	Secondary	Adaptation/mitigation at systems level Adaptation/mitigation at individual level	Decreased vulnerability to disasters (P) Reduced fertility limits pressure on resources and environmental degradation (P) Reduced fertility limits CO2 emissions (P)
	Psaki <i>et al.</i> (2019)	Global (developing)	Secondary	Adaptation/mitigation at systems level	Reduced fertility limits CO2 emissions (M)
45	Qauk (2020)	Africa (where multiple countries)	Secondary	Adaptation/mitigation at systems level	Reduced fertility limits CO2 emissions (M)
	Roy and Chouhan (2021)	India	Primary and empirical	Disruption at individual level	Child marriage (P)
	Saigal <i>et al.</i> (2021)	India	Primary and empirical	Adaptation/mitigation at individual level	Increased environmental concern/greener life choices (N)
47	Samir (2013)	Nepal	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P)
48	Sperling and Winthrop (2015)	Global (developing)		Adaptation/mitigation at individual level Adaptation/mitigation at household or community level	Decreased vulnerability to disasters (P) Increased household and community preparedness and resilience (P)
49	Striessnig <i>et al.</i> (2013)	Global (developing)	Primary and empirical	Adaptation/mitigation at individual level	Decreased vulnerability to disasters (P)

50	UNESCO (2015)	Bangladesh	Primary and empirical	Disruption at school level Disruption at household/community level Disruption at individual level	Damage to infrastructure (P) Supply of teachers (P) Schools repurposed (P) Forced displacement/migration (P) Increased domestic labour (P) Injury/death/illness (P)
51	Vincent <i>et al.</i> (2014)	Global (developing)	Secondary	Adaptation/mitigation at household or community level Disruption at individual level	Increased violence and exploitation (P) Injury/death/illness (P) Greener livelihood choices (P)
52	Webb (2020)	Vanuatu	Primary and empirical	Adaptation/mitigation at systems level	Women's participation results in better DRR/lower vulnerability (P)
Inclusive set					
53	Adejuwon (2018)	Nigeria	Primary and empirical	Disruption at household/community level	Choice of boys over girls in school (M)
54	Aryal (2014)	Nepal	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P)
55	Atkinson and Bruce (2015)	Global (developing)	Theoretical or conceptual	Disruption at systems level Disruption at household/community level Disruption at individual level	Conflict and instability (P) Choice of boys over girls in school (P) Increased violence and exploitation (P) Increased domestic labour (P)
56	Balls (2016)	Vietnam	Primary and empirical	Adaptation/mitigation at individual level	Increased environmental concern/greener life choices (P)
	Bangay (2022)	Global (developing)	Theoretical or conceptual	Disruption at household/community level Disruption at individual level Disruption at school level Adaptation/mitigation at individual level Adaptation/mitigation at systems level	Forced displacement/migration (P) Increased domestic labour (P) Injury/death/illness (P) Seasonal patterns shift (P) Decreased vulnerability to disasters (P)

					Increased environmental concern/greener life choices (M) Reduced fertility limits pressure on resources and environmental degradation (P) Women contribute to the green economy (M)
57	Bee and Sijapati (2017)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at systems level	Women's participation in environmental programmes increases their effectiveness (M)
58	Chigwanda (2016)	Zimbabwe	Theoretical or conceptual	Disruption at household/community level Disruption at individual level Disruption at systems level	Resources diverted from education (P) Increased poverty (P) Choice of boys over girls in school (M) Malnutrition (P) Increased domestic labour (P) Child marriage (P)
59	Education Cannot Wait (2020)	Global (developing)	Theoretical or conceptual	Disruption at school level	Damage to infrastructure (P) Schools repurposed (P)
60	Feinstein and Mach (2020)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at individual level Adaptation/mitigation at household or community level	Decreased vulnerability to disasters (P) Increased household and community preparedness and resilience (P)
61	Haneef and Tembe (2019)	Mozambique	Primary and empirical	Disruption at school level	Damage to infrastructure (P) Schools repurposed (P)
62	Hemachandra <i>et al.</i> (2020)	Sri Lanka	Primary and empirical	Adaptation/mitigation at systems level	Women's participation results in better DRR/lower vulnerability (M)
63	IDMC (2020b)	Africa (where multiple countries)	Primary and empirical	Disruption at school level Disruption at household/community level	Damage to infrastructure (P) Forced displacement/ migration (P)

64	Jerneck (2015)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at systems level	Women contribute to the green economy (M)
65	Khapung (2016)	Nepal	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (P)
66	Kwauk (2020)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at individual level Adaptation/mitigation at systems level	Increased environmental concern/greener life choices (M) Girls' education leads to increased emissions through consumption/urbanisation/aging population (M)
67	Kwauk and Braga (2017)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at systems level	Women's higher political and/or economic status associated with greener outcomes (P) Women contribute to the green economy (P) Reduced fertility limits CO2 emissions (P)
68	Kwauk and Casey (2021)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at systems level	Women contribute to the green economy (P)
	Kwauk and Winthrop (2021)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at school level	More climate resilient schools (P)
	Liu <i>et al.</i> (2021)	Democratic Republic of Congo	Primary and empirical	Adaptation/mitigation at systems level	Women's participation in environmental programmes increases their effectiveness (P)
69	Lutz and Streissnig (2015)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at systems level	Women contribute to the green economy (M) Reduced fertility limits CO2 emissions (M) Girls' education leads to increased emissions through

					consumption/urbanisation/aging population (M)
70	Malala Fund (2021a)	Global (developing)	Theoretical or conceptual	Disruption at household/community level Disruption at individual level	Choice of boys over girls in school (P) Increased violence and exploitation (P) Child marriage (P)
	Malala Fund (2021b)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at individual level	Increased environmental concern/greener life choices (P)
71	Namukombo (2016)	Zambia	Primary and empirical	Adaptation/mitigation at systems level	Women contribute to the green economy (M)
72	Opiyo <i>et al.</i> (2014)	Kenya	Primary and empirical	Disruption at systems level Disruption at household/community level Disruption at individual level	Conflict and instability (P) Increased poverty (P) Malnutrition (P) Injury/death/illness (P)
73	Parsitau <i>et al.</i> (2017)	Kenya	Theoretical or conceptual	Disruption at household/community level	Choice of boys over girls in school (P)
	Patnaik (2021)	Senegal	Primary and empirical	Adaptation/mitigation at household or community level	Greener livelihood choices (P)
74	Plan International (2019)	Global (developing)	Theoretical or conceptual	Disruption at individual level Adaptation/mitigation at individual level Adaptation/mitigation at household or community level	Malnutrition (P) Child marriage (P)

75	Post Cyclone Idai Cabinet for Reconstruction (2019)	Mozambique	Primary and empirical	Disruption at school level	Damage to infrastructure (P) Schools repurposed (P)
76	Project Drawdown n.d.	Global (developing)	Primary and empirical	Adaptation/mitigation at systems level	Reduced fertility limits CO2 emissions (P)
77	Rao <i>et al.</i> (2019)	Global (developing)	Primary and empirical	Disruption at individual level	Increased domestic labour (P)
78	Sarabhai, K., and Vyas, P. (2017)	Global (developing)	Primary and empirical	Adaptation/mitigation at household or community level	Increased household and community preparedness and resilience (P) Greener livelihood choices (P) Greener household behaviours (P)
	Save the Children (2021)	Global (developing)	Primary and empirical	Disruption at school level Disruption at household/community level Disruption at individual level	Damage to infrastructure (P) Increased poverty (P) Forced displacement/ migration (P) Malnutrition (P) Increased violence and exploitation (P) Injury/death/illness (P) Child marriage (P)
79	Send My Friend to School (2020)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at individual level Adaptation/mitigation at household or community level Disruption at school level Disruption at household/community level	Damage to infrastructure (P) Choice of boys over girls in school (P) Forced displacement/ migration (P) Decreased vulnerability to disasters (P) Increased household and community preparedness and resilience (P)
80	Sen-Roy (2018)	Global (developing)	Theoretical or conceptual	Disruption at individual level	Malnutrition (P) Injury/death/illness (P)
81	Sims, K. (2021)	Global (developing)	Secondary	Disruption at systems level Disruption at school level Disruption at household/community level Disruption at individual level Adaptation/mitigation at household or community level Adaptation/mitigation at individual level	Resources diverted from education (P) Gender inequality entrenched (P) Damage to infrastructure (P) Schools repurposed (P) Choice of boys over girls in school (M) Forced displacement/ migration (P) Injury/death/illness (P) Child marriage (P) Decreased vulnerability to disasters

					(P)Reduced fertility limits pressure on resources and environmental degradation (P)Increased environmental concern/greener life choices (P)Increased household and community preparedness and resilience (P)Women's higher political and/or economic status associated with greener outcomes (P)Women contribute to the green economy (P)Reduced fertility limits CO2 emissions (M)
82	Sugden <i>et al.</i> (2014)	Asia (where multiple countries)	Secondary	Disruption at household/community level Disruption at individual level	Forced displacement/ migration (P) Malnutrition (P) Increased violence and exploitation (P) Increased domestic labour (P) Injury/death/illness (P) Child marriage (P)
83	UN Women and UNICEF (2019)	Global (developing)	Secondary	Disruption at individual level	Malnutrition (P) Increased violence and exploitation (P) Increased domestic labour (P) Injury/death/illness (P)
84	UNDP (2020)	Global (developing)	Theoretical or conceptual	Disruption at household/community level Disruption at individual level Adaptation/mitigation at individual level Adaptation/mitigation at systems level	Increased poverty (P) Forced displacement/ migration (P) Malnutrition (P) Injury/death/illness (P) Decreased vulnerability to disasters (P) Increased environmental concern/greener life choices (P) Reduced fertility limits CO2 emissions (M) Girls' education leads to increased emissions through consumption/urbanisation/aging population (M)

85	UNESCO (2020)	Global (developing)	Theoretical or conceptual	Disruption at household/community level	Forced displacement/ migration (P)
86	UNICEF (2020)	Global (developing)	Theoretical or conceptual	Adaptation/mitigation at systems level	Women contribute to the green economy (P)

Appendix D – Primary and empirical study quality scoring

Citation	Conceptual framing	Transparency	Methodology	Culturally appropriate	Validity	Reliability	Cogency	Composite score	Score
Adejuwon (2018)	1	2	1	3	2	1	1	1.57	Low
Afolabi et al. (2017)	2	3	2	3	2	1	3	2.29	Moderate
Alston et al. (2014)	2	2	2	2	1	2	3	2.00	Moderate
Anik et al. (2021)	2	2	2	2	2	2	2	2	Moderate
Aryal et al. (2020)	2	3	3	3	2	2	3	2.57	High
Aryal (2014)	1	1	1	3	1	1	2	1.43	Low
Assan et al. (2018)	3	2	2	2	2	2	2	2.14	Moderate
Austin and McKinney (2016)	3	3	3	3	2	2	3	2.71	High
Azong et al. (2018)	1	2	1	3	1	1	2	1.57	Low
Baker-Médard and Sasser (2020)	2	1	2	3	1	1	3	1.86	Moderate
Balls (2016)	2	1	2	2	1	1	2	1.57	Low
Batool et al. (2018)	2	2	2	2	1	1	2	1.71	Moderate

Centre for Environment Education; Australia (2016)	2	1	1	2	1	1	2	1.43	Low
Clery and Rhead (2013)	2	2	2	2	2	2	2	2.00	Moderate
Cook et al. (2019)	2	2	3	3	1	2	3	2.29	Moderate
Debesai (2020)	1	2	2	2	1	2	2	1.71	Moderate
Eastin (2018)	2	3	3	3	2	2	3	2.57	High
Ergas and York (2012)	2	3	3	3	2	2	3	2.57	High
Ergas et al. (2021)	2	2	2	3	2	2	2	2.14285714	Moderate
Forbes-Genade and van Niekerk (2017)	2	1	2	2	2	2	2	1.86	Moderate
Gebre et al. (2018)	2	1	2	2	1	2	2	1.71	Moderate
Grace et al. (2015)	2	2	2	2	1	1	2	1.71	Moderate
Grillos (2018)	2	1	2	2	2	1	3	1.86	Moderate
Haneef and Tembe (2019)	1	1	2	2	1	1	2	1.43	Low
Hemachandra et al. (2020)	1	1	2	2	1	1	2	1.43	Low
Hyland and Russ (2019)	2	2	3	3	3	2	3	2.57	High
IDMC (2020b)	2	1	2	2	1	1	2	1.57	Low
IDMC (2020a)	2	3	2	2	3	2	3	2.43	High

Islam and Sharma (2021)	2	3	2	2	2	1	2	2	Moderate
Khapung (2016)	1	1	1	2	1	1	2	1.29	Low
Khoza et al. (2019)	1	1	2	2	2	2	3	1.86	Moderate
Komatsu and Rappleye (2018)	1	2	2	2	2	1	2	1.71	Moderate
Langnel et al. (2021)	2	2	2	2	1	1	2	1.71	Moderate
Lie et al. (2021)	1	2	2	1	2	1	1	1.42857143	Low
Lv and Deng (2019)	2	3	2	2	3	2	3	2.43	High
Lv et al. (2020)	2	2	2	2	2	2	3	2.14	Moderate
Masson et al. (2019)	2	2	2	2	2	1	2	1.86	Moderate
Matewos (2019)	2	2	2	2	1	2	2	1.86	Moderate
Mavisakalyan and Tarverdi (2019)	2	2	3	3	2	2	3	2.43	High
McGee et al. (2020)	2	2	2	3	2	2	3	2.29	Moderate
McKinney and Fulkerson (2015)	3	3	2	3	2	2	3	2.57	High
McLeod et al. (2018)	2	2	2	3	1	2	2	2.00	Moderate
Mottaleb et al. (2015)	2	2	3	3	2	3	2	2.43	High
Namukombo (2016)	1	1	1	2	1	1	2	1.29	Low
Nhem and Lee (2019)	2	2	2	2	1	1	2	1.71	Moderate

Nordstrom and Cotton (2020)	2	2	3	2	3	2	3	2.43	High
Nzaboni et al. (2021)	2	3	2	3	1	1	2	2	Moderate
Opiyo et al. (2014)	1	2	2	2	1	1	2	1.57	Low
Padmaja et al. (2020)	1	2	2	2	2	1	2	1.71	Moderate
Patel et al. (2020)	3	2	2	2	2	2	2	2.14	Moderate
Patnaik (2021)	2	1	1	2	1	1	2	1.42857143	Low
PostCyclone Idai Cabinet for Reconstruction (2019)	1	1	1	2	2	2	2	1.57	Low
Project Drawdown n.d.	1	2	1	2	1	1	2	1.43	Low
Rao et al. (2019)	2	1	1	2	1	1	2	1.43	Low
Roy Choudary et al. (2021)	2	3	2	2	2	2	3	2.29	Moderate
Roy and Chouhan (2021)	2	2	2	2	2	1	2	1.85714286	Moderate
Saigal et al. (2021)	1	2	2	2	2	1	2	1.71428571	Moderate
Samir (2013)	2	2	2	2	2	2	2	2.00	Moderate
Save the Children (2021)	2	1	1	2	1	1	3	1.57142857	Low
Striessnig et al. (2013)	2	2	2	3	1	1	3	2.00	Moderate
UNESCO (2015)	1	3	2	3	2	2	2	2.14	Moderate

Webb (2020)	2	2	2	2	1	1	2	1.71	Moderate
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