

TOPIC GUIDE:

Education, Climate and
Environment



Nicole Blum

March 2015

About Evidence on Demand and Professional Development

Evidence on Demand supports the professional development of Climate, Environment, Infrastructure and Livelihoods Advisers at DFID. Technical Competency Frameworks for the advisory groups guide the support provided. Evidence on Demand also supports cross-cutting or development competencies which cover areas of technical knowledge and skills needed by advisers to effectively deploy their core technical skills and knowledge in development policy and operations.

The Evidence on Demand team is led by a DAI (which incorporates HTSPE Limited) and IMC Worldwide Limited Joint Venture. Both firms are established development consultancies with considerable experience in managing resource centres. The Joint Venture is backed by a core consortium of specialist organisations. The consortium provides technical support for developing quality assured resources, answering helpdesk enquiries and supporting consultancy services. Please go to the Evidence on Demand website (www.evidenceondemand.info) for further details.

Disclaimer

This Topic Guide has been produced by Evidence on Demand with the assistance of the UK Department for International Development (DFID) contracted through the Climate, Environment, Infrastructure and Livelihoods Professional Evidence and Applied Knowledge Services (CEIL PEAKS) programme, jointly managed by DAI (which incorporates HTSPE Limited) and IMC Worldwide Limited.

The views expressed in the Topic Guide are entirely those of the authors and do not necessarily represent DFID's own views or policies, or those of Evidence on Demand. Comments and discussion on items related to content and opinion should be addressed to the author, via enquiries@evidenceondemand.org.

Your feedback helps us ensure the quality and usefulness of all knowledge products. Please email enquiries@evidenceondemand.org and let us know whether or not you have found this material useful; in what ways it has helped build your knowledge base and informed your work; or how it could be improved.

DOI: http://dx.doi.org/10.12774/eod_tg.march.blumn

First published March 2015
© CROWN COPYRIGHT



Contents

About Topic Guides.....	iv
Tips for using Topic Guides.....	v
Summary of and key lessons from this Topic Guide	vi
Finding your way around the document.....	vii
SECTION 1.....	1
Introduction	1
Links with DFID’s Resilience Framework	1
DFID’s Resilience Framework	2
Defining resilience	2
DFID’s four elements of resilience	2
Relevance of DFID’s Resilience Framework to education, environment and climate change.....	3
Educational contributions to increasing resilience	4
SECTION 2.....	6
Impacts of climate and environmental change on education.....	6
Impacts on education systems and infrastructure.....	6
Existing evidence from research and practice	6
Potential future costs for education related to climate change.....	7
Impacts on learning and access to education.....	8
Existing evidence from research and practice	8
Case Study 1 Schools for pastoralist children.....	8
Impact on girls’ education	9
Impact on cognitive development and broader development goals	9
Impact on school attendance as a result of health impacts.....	9
SECTION 3.....	11
The role of education in addressing environmental and climate change: evidence from research	11
Approaches and definitions	11
Evidence of impact	12
Quality matters	12
SECTION 4.....	13
Key issues in responding to environmental and climate challenges.....	13
1. Building ‘climate resilient’ education infrastructure	13



	Planning and design responses	13
	Case Study School construction to minimise environmental impacts .	14
	Case Study 3 Climate resilient school design	15
	Wider impacts through design	15
	Low carbon technologies	15
	Case Study 4 DFID Nigeria’s Education Sector Support Programme.	16
2.	Considering climate and environmental change within education systems planning	17
	Accounting for extreme weather events, incremental environmental change and seasonal shifts	17
	Case Study 5 DFID Bangladesh Primary Education Development Programme 3 (PEDP3)	17
	Planning for population displacement and migration	18
3.	Enhancing key areas of knowledge and skills within education	18
	Knowledge of global climate change and wider environmental processes	19
	Knowledge of local environmental and climatic conditions, associated risks and management strategies	19
	Disaster risk reduction and adaptation to climate change	19
	Case Study 6 Children as agents of change for disaster risk reduction	20
	Health risks associated with climate change	21
	Integrating key knowledge and skills into education systems	21
	Tailoring the provision of knowledge and skills to the needs of different learners	21
	Case Study 7 Promoting spatial thinking in natural resource management, Rwanda	22
	Increasing professional and technical knowledge	22
4.	Improving approaches to teaching and learning within formal education	23
	Understanding learning	23
	Developing effective teaching approaches	24
	Support for teacher education	24
	Case Study 8 Education for sustainable development teacher training course, Costa Rica	25
	Case Study 9 Teaching and learning approaches for education for sustainable development in Thailand	26
5.	Integrating learning about climate and environment into nonformal/community education	26



Benefits for women and girls.....	27
Case Study 10 Green Belt Movement, Kenya	27
Community-based adaptation	28
International experience in CBA	28
SECTION 5.....	30
Integrating climate and environmental issues into education: short, medium and long term responses	30
Short-term responses	31
Medium-term responses.....	31
Long-term responses.....	32
SECTION 6.....	33
Challenges and opportunities	33
Challenges.....	33
Opportunities	34
References.....	35
Where to go for more information.....	42

List of Figures

Figure 1 DFID's Resilience Framework.....	3
Figure 2 Educational contributions to increasing resilience	4
Figure 3 Educational responses to climate and environmental change	30



About Topic Guides

Welcome to the Evidence on Demand series of Topic Guides. The guides are produced for Climate, Environment, Infrastructure and Livelihoods Advisers in the UK Department for International Development (DFID). There will be up to 30 Topic Guides produced 2013-2014.

The purpose of the Topic Guides is to provide resources to support professional development. Each Topic Guide is written by an expert. Topic Guides:

- Provide an overview of a topic;
- Present the issues and arguments relating to a topic;
- Are illustrated with examples and case studies;
- Stimulate thinking and questioning;
- Provide links to current best 'reads' in an annotated reading list;
- Provide signposts to detailed evidence and further information;
- Provide a glossary of terms for a topic.

Topic Guides are intended to get you started on an unfamiliar subject. If you are already familiar with a topic then you may still find a guide useful. Authors and editors of the guides have put together the best of current thinking and the main issues of debate.

Topic Guides are, above all, designed to be useful to development professionals. You may want to get up to speed on a particular topic in preparation for taking up a new position, or you may want to learn about a topic that has cropped up in your work.

This Topic Guide will be particularly useful to DFID Advisers working in education, environment and climate change, and infrastructure. It is also envisioned that it will be of use to humanitarian advisors working in communities post-disaster in order to 'build back better' and to those working on issues related to health and climate change.

More broadly, whether you are a DFID Climate, Environment, Infrastructure or Livelihoods Adviser, an adviser in another professional group, a member of a development agency or non-governmental organisation, a student, or a researcher we hope that you will find Topic Guides a valuable resource.



Tips for using Topic Guides

I am going to be under the spotlight. How can a Topic Guide help?

The Topic Guides, and key texts referred to in the guides, cover the latest thinking on subject areas. If you think that a specific issue might be raised when you are under the spotlight, you can scan a Topic Guide dealing with that issue to get up to speed. To enable rapid navigation of subject areas within the Topic Guide a hyper linked quick reference chart is included on page viii. You can click on the section or subsection title to skip to your area of interest.

I have just joined as an adviser. Where should I start?

Topic Guides are peer reviewed and formally approved by DFID. They are a good starting point for getting an overview of topics that concern DFID. You can opt to be alerted to new Topic Guides posted on the Evidence on Demand website through Facebook, Twitter or LinkedIn. New publications of interest to advisers will also be announced in Evidence on Demand quarterly ebulletins.

I don't have much time. How long should I set aside for reading a Topic Guide?

The main text of a Topic Guide takes around three hours to read. To get a good understanding of the topic allow up to three hours to get to grips with the main points. Allow additional time to follow links and read some of the resources.

I need to keep up my professional development. How can Topic Guides help with this?

Topic Guides, while providing an overview and making key resources easy to access, are also meant to be stretching and stimulating. The annotated reading lists point to material that you can draw on to get a more in-depth understanding of issues. The Topic Guides can also be useful as aide mémoires because they highlight the key issues in a subject area. The guides also include glossaries of key words and phrases.

I would like to read items in the reading list. Where can I access them?

Most resources mentioned in the Topic Guides are readily available in the public domain. Where subscriptions to journals or permissions to access to specialist libraries are required, these are highlighted.

I have a comment on a guide. How can I provide feedback?

Evidence on Demand is keen to hear your thoughts and impressions on the Topic Guides. Your feedback is very welcome and will be used to improve new and future editions of Topic Guides. There are a number of ways you can provide feedback:

- Use the Have Your Say section on the Evidence on Demand website (www.evidenceondemand.info). Here you can email our team with your thoughts on a guide. You can also submit documents that you think may enhance a Topic Guide. If you find Topic Guides useful for your professional development, please share your experiences here.
- Send an email to the Evidence on Demand Editor at enquiries@evidenceondemand.org with your recommendations for other Topic Guides.



Summary of and key lessons from this Topic Guide

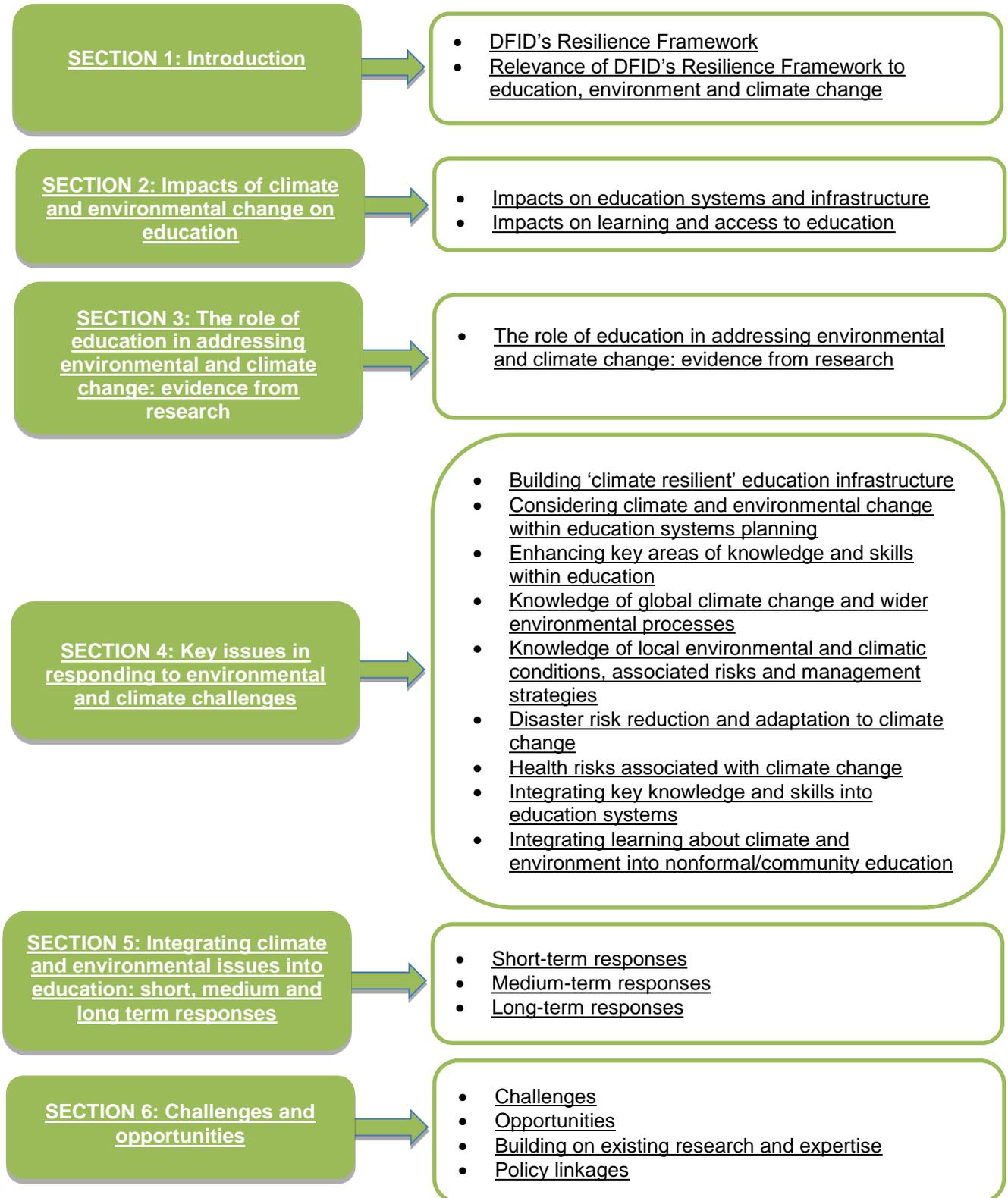
This Topic Guide sets out the existing knowledge around the links between education, climate and environment. In particular, it highlights the two-way relationship between these key areas, including:

- The **risks and opportunities** posed by environmental and climatic factors on educational supply and demand at all levels (primary, secondary, tertiary) and modes (formal and informal).
- The role education and educational infrastructure can play in **building the resilience of communities** (particularly poor and vulnerable population groups) to climate and environmental change, and the potential opportunities provided by low carbon technology and environmentally-sensitive construction and design in that process.



Finding your way around the document

The chart below is a guide that enables quick navigation through the document. Click on the section or subsection title to skip to your area of interest.





The discussion begins by highlighting the links between DFID's Resilience Framework and education responses to climate and environmental change (**Section 1**). Education can play a key role in helping to build the resilience of individuals and communities by providing a range of knowledge and skills to cope with uncertainty and change. It can therefore help to decrease exposure to risk and sensitivity to environmental disturbance as well as to increase adaptive capacity.

Section 2 provides an overview of existing research on the impacts of climate and environmental change on education, in terms of both infrastructure (e.g. loss of or damage to school buildings or transportation networks) as well as learning and access (e.g. disruptions due to extreme weather events). While much of this work to date has focused on reactive interventions to natural disasters, a growing body of work has explored the impacts of incremental environmental change (e.g. salination, loss of water supplies, soil erosion) on access, learning and health. This may have particularly negative impacts on education provision for women and other vulnerable populations.

Section 3 explores the existing research on the potential role of education in fostering sustainable development in the face of environmental and climate change. This includes a very strong body of international work in environmental education, education for sustainable development, and climate change education. This work has clearly shown the positive impacts that well-designed education interventions can have for both individuals and communities, particularly when active-learning strategies which support learners to develop knowledge and skills relevant to local contexts and needs are used.

Based on these discussions, the Topic Guide then outlines the **key areas which an educational response to climate and environmental change should take into account (Section 4)** and how these can be integrated into **short, medium and long-term education responses (Section 5)**. The **key lessons** from existing research and knowledge around education, climate and environment are the need to:

Build 'climate resilient' and green education infrastructure both in terms of new development as well as 'building back better' after a disaster. Attention to the siting and design of educational institutions can deliver multiple benefits including buildings which are cheaper and more environmentally friendly to build, operate and maintain, and are safer and more resilient in the face of environmental impacts. Low carbon design of education infrastructure can also have multiple environmental and social benefits.

Consider climate and environmental change within education systems planning. This will need to encompass planning for infrastructure development and improvement, as well as strategies for ensuring access and quality learning in the face of environmental and climate change impacts. Two particular issues of concern are changes in seasonality, which has implications for the timing of important processes such as school building and maintenance, the examination cycle and textbook distribution; and growing numbers of internal and external migrants as a result of the increased incidence of natural disasters and incremental environmental change, which has implications for access and quality.

Enhance key areas of knowledge and skills within education. Although educational responses to environmental and climate change should not consist solely of adding new 'inputs' to curricula, addressing climate change (and promoting sustainable development more generally) does require the promotion of some key areas of knowledge and skills. These include knowledge of (i) global climate change and environmental processes, (ii) local environmental conditions, associated risks and management strategies, (iii) disaster risk reduction and adaptation, and (iv) health risks associated with climate change. Attention to these areas of knowledge is needed at all levels (primary, secondary, tertiary and adult



education) as well as via diverse modes of delivery (formal, nonformal, professional development).

Improve approaches to teaching and learning within formal education. Evidence from research and practice clearly shows that educational programmes need to not only include these key areas of knowledge and skills, but to address them through effective approaches to teaching and learning. Strategies such as activity-based and problem-based learning, and techniques such as case studies, simulations, role playing and group discussions encourage learners to develop the knowledge, skills and capacities which enable them to think critically, solve problems and address uncertainty – all of which are key to addressing climate and environmental change.

Integrate learning about climate and environment into nonformal/community education. Learning, skill development and awareness-building related to climate and environmental change can be usefully encouraged through a range of nonformal initiatives aimed at local leaders, parents and particular local or professional groups (e.g. in agriculture, engineering, construction, food production and distribution, healthcare). Such initiatives can help to develop leadership in local sustainability and to build the resilience of communities effected by environmental and climate change. Focusing community-based efforts on women and girls can have particularly strong impacts.

The Topic Guide concludes with a discussion of the **key challenges and opportunities** for education responses to climate and environmental change (**Section 6**). In particular, there is a need to:

- Design interventions which give attention to specific local contexts and needs;
- Give greater attention to the needs of women, girls and a range of vulnerable population groups, particularly given their greater vulnerability to climate change impacts;
- Provide more support in the preparation of educators at all levels to deal with the challenges of teaching and learning around climate and environmental change.

Case studies have been integrated throughout the text to show how key ideas and approaches are already being put into practice in education systems around the world. A range of resources for further information are also provided at the end of the text.



SECTION 1

Introduction

Climate and environmental change have particular implications for education and learning, including direct impacts on education infrastructure, access and learning.

The increasing incidence of severe weather events as well as incremental environmental change represent a significant financial burden for already constrained education budgets, and can result in severe disruptions to education systems. Both of these factors have the potential to undermine efforts to improve the quality of education provision. Where the potential impacts of climate change on existing educational infrastructure (including schools, transportation, and learning materials) and systems are taken into account in terms of emergency response, and as part of advance planning and project development processes, investment is likely to be more efficient.

Education has a key role to play in efforts aimed at mitigation and adaptation to climate change. Education provides the knowledge, skills and competencies that can influence an individual's adaptive capacity, for example through increasing overall knowledge, awareness of risks and ability to manage change. Indirectly, education can also improve socioeconomic status, as well as increase social capital and access to networks that which can provide support in times of need. Poverty, gender and social inequality are major causes of climate vulnerability, so well-designed education responses to climate and environmental change have the potential to impact simultaneously on multiple development goals.

This Topic Guide summarises what is known about the two-way relationship between education and environmental management, climate variability and change. This includes:

- The risks and opportunities posed by environmental and climatic factors on educational supply and demand at all levels (primary, secondary, tertiary) and modes (formal and informal);
- The role education and educational infrastructure can play in building the resilience of communities (particularly poor and vulnerable population groups) to climate and environmental change, and the potential opportunities provided by low carbon technology and environmentally-sensitive construction and design in that process.

Links with DFID's Resilience Framework

The guide makes specific links to [DFID's Resilience Framework](#). It outlines the need to integrate initiatives from a range of interest groups in order to deal effectively with the multidimensional demands of environmental and climate change. Comments are included throughout the guide about the strength of available bodies of evidence from research and practice (DFID 2014: 20) and links to supporting documentation are provided where possible.



DFID's Resilience Framework

Defining resilience

A growing body of research in international development has sought to:

- (i) Understand what the properties are that make a country, community or household resilient;
- (ii) Establish the principles and processes which strengthen that resilience; and
- (iii) Build the evidence for what projects and programmes really help people to withstand and recover from disasters.

The concept of resilience can be applied to work in a range of areas, including growth and governance, but has particular relevance for environmental and climate change.

There are a range of definitions of resilience in the research and policy literature (cf. Weichselgartner and Kelman 2014; Bahadur et al. 2013). The subject has been taken up in various disciplines and fields, including geography, engineering, psychology and ecology. One common thread in these discussions is an emphasis on the ability of materials, individuals, organisations and entire social–ecological systems to withstand severe conditions and to absorb shocks:

The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions. (IPCC 2012: 563)

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. (UNISDR 2009: 24)

The ability of assets, networks and systems to anticipate, absorb, adapt to and/or rapidly recover from a disruptive event. (Cabinet Office 2011: 14)

DFID's four elements of resilience

DFID's own working definition sees disaster resilience as follows: 'the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses – such as earthquakes, drought or violent conflict – without compromising their long-term prospects' ([DFID 2011](#)). This definition is supported by a resilience framework organised around four elements:

Context: Whose resilience is being built? (e.g. a social group, a socioeconomic or political system, an environmental context, an institution);

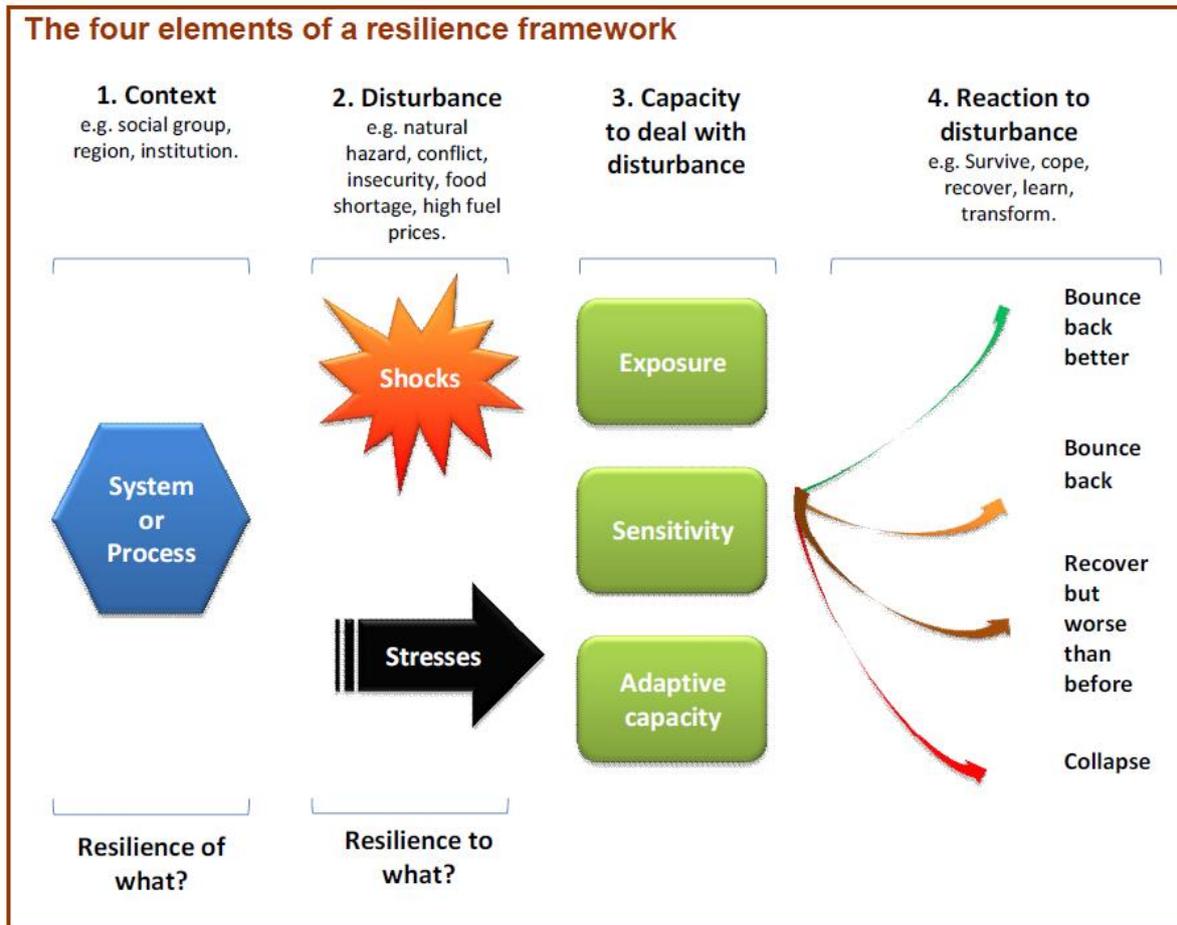
Disturbance: What kind(s) of shocks (sudden events like conflict or disasters) and/or stresses (long-term trends like resource degradation, urbanisation or climate change) need to be addressed?

Capacity to respond: What is the ability of a group/system/process to deal with a shock or stress? This will depend on *exposure* (the magnitude of the shock or stress), *sensitivity* (the degree to which a system will be affected by, or will respond to, a given shock or stress), and **adaptive capacity** (how well it can adjust to a disturbance or moderate damage, take advantage of opportunities and cope with the consequences of a transformation);

Reaction: A range of responses are possible, including:

- (i) *Bounce back better*, where capacities are enhanced, exposures are reduced and the system is more able to deal with future shocks and stresses;
- (ii) *Bounce back*, where pre-existing conditions prevail; or
- (iii) *Recover, but worse than before*, meaning capacities are reduced. In the worst-case scenario, the system collapses, leading to a catastrophic reduction in capacity to cope in the future.

Figure 1 DFID's Resilience Framework



Relevance of DFID's Resilience Framework to education, environment and climate change

The resilience framework has particular relevance to DFID's work in education, environment and climate change. Education has a range of direct and indirect effects which can enhance the capacity of individuals, groups and systems to cope with environmental disturbance (element 3 above), and therefore to increase the likelihood of 'bouncing back better'. Conversely, failure to do so could lead to a situation of 'recover, but worse than before', or even collapse.

Where capacity to cope with disturbance is increased, this could potentially also lead to a decreased incidence of some kinds of disturbance (element 2 of the resilience framework) in the future. More resilient systems and communities, for instance, may be less likely to



experience food shortages brought on by unsustainable agricultural production or local conflicts that result from the lack of key resources.

Educational contributions to increasing resilience

Figure 2 below provides a summary of the potential contributions that an effective educational response can have in increasing the capacity of individuals, communities and education systems to cope with climate and environmental change. It also highlights where these are addressed in detail in the sections that follow.

Figure 2 Educational contributions to increasing resilience



Education can also improve socioeconomic status and thereby increase adaptive capacity more generally. Through improvements in socioeconomic status individuals might have greater access to resources, such as insurance; be able to live in lower risk areas, and afford higher quality housing, etc. They may also increase their social capital and have greater access to networks that can provide support in times of need (Muttarak and Lutz 2014).

Well-designed education responses to climate and environmental change therefore have the potential to impact simultaneously on multiple development goals. This includes ongoing efforts to reduce poverty, improve sustainability, support greater social and



gender equality and provide quality education in developing countries through international policy initiatives such as the Millennium Development Goals, the UN Decade for Education for Sustainable Development (2005-2014), and the more recent [Education First Initiative](#).

There are also links to broader international agreements related specifically to climate change such as the UN Framework Convention on Climate Change (especially Article 6: Education, Training and Public Awareness) and the Hyogo Framework for Action (cf. Priority 3). Although the details of the post-2015 international development agenda have yet to be fully determined, there are clear indications that greater attention will be focused on the links between education quality and sustainable development (cf. [UNESCO & UNICEF 2013](#)).

As will be discussed in the following sections, effective responses to environmental and climate change need to give attention to the development and maintenance of education infrastructure and systems planning, as well as to teaching and learning in formal and nonformal education.



SECTION 2

Impacts of climate and environmental change on education

There is a small, but growing, body of research examining the impacts of climate and environmental change on education. These include, a small but strong body of evidence regarding the direct effects of extreme weather events (e.g. drought, flooding, cyclones, heat waves) as well as incremental environmental change (e.g. sea level change, salination, changes in seasonal weather patterns, desertification, soil erosion, species loss, etc.) on education provision. Rehabilitation/rebuilding of educational infrastructure in both cases results in disruptions to educational programming as well as a significant financial burden for already constrained education budgets. Extreme weather events and their aftermath, as well as to incremental environmental change, therefore have the potential to undermine investment in improvement in the quality of education provision.

Climate change impacts are likely to contribute to deterioration in broader development goals, including education, particularly for girls. A small but strong body of work (largely in the discipline of economics) illustrates that associated reductions in household income are likely to influence decisions regarding the number and gender of children sent to school as well as whether or not there is continued support for their attendance. Moreover, deteriorating livelihoods are likely to increase the time required to secure clean water and fuel, and to care for siblings and the sick. Resulting gaps in access and attendance have a significant impact on individuals' learning in the short-term, and their earning potential and the wider human development of communities and nations in the long term. Research suggests that in all instances such effects are likely to disproportionately affect girls and impact on gender equity and female student performance.

The following sections explore the available evidence from research and practice regarding the impacts of climate and environmental change on education systems and infrastructure as well as learning and access.

Impacts on education systems and infrastructure

Existing evidence from research and practice

Relatively little attention has been given to the impacts of climate change specifically on education systems, though there is substantial research investigating the impacts of climate change on development, growth and infrastructure in general (cf. Bowen et al. 2012; Dasgupta et al. 2013). There is also little data to show the impacts of incremental environmental change on education. This may be because of the difficulty of directly measuring such changes, although the potential for displacement of large numbers of people due to sea level rise is clearly significant. Existing data on these issues is mostly based on reactive interventions to extreme weather events, many of which are likely to increase in frequency and/or intensity during the course of the 21st century (IPCC 2013: 5).

Despite the lack of research, however, recent experience from around the world has shown the following:

- 
- In Bangladesh, the 2007 Cyclone Sidr left 74 government primary schools destroyed and another 8,817 damaged. An estimated 103,664 children were affected as a result. The estimated cost of reconstruction and refurbishment for the education sector was more than US\$82 million (Das 2008);
 - In Cambodia, the 2000 flood destroyed approximately 18% of the country's schools, impacting upon the education of 500,000 children and costing US\$1.6 million in rehabilitation costs. Subsequent research in Cambodia has demonstrated that school absenteeism and drop out rates are higher in flood-prone areas;
 - In Taiwan, the 2009 Typhoon Morakot caused the second highest school facility damage in the history of Taiwan, with 1,328 schools damaged, 13 schools in need of relocation, and overall school facility losses of almost NT\$2.9 billion [approximately US\$86.7 million] (Chen and Lee 2012: 542-543);
 - There is general evidence that flooding inhibits completion of schooling, with schools located in flood-prone areas subject to at least one and a half months of closure due to flooding (Asian Disaster Preparedness Center 2008);
 - In India, recent research on the impacts of natural disasters highlighted the heavy costs for education over the last decade (Bangay 2013). The study cites evidence from a range of disasters. The two cyclones that hit Orissa in 2009, for instance, left more than 10,000 dead, over 7,000 primary schools destroyed and the education of more than 2 million children severely disrupted. The 2004 tsunami destroyed 360 primary and secondary schools and impacted an estimated 454,000 students along coastal India and the Andaman and Nicobar islands (United Nations 2006). Also in 2004, floods destroyed more than 43,000 primary school classrooms and 166 secondary schools in Bihar, one of India's poorest states. Rebuilding and refurbishment efforts cost an estimated US\$40 million (UNICEF 2004);
 - In addition to the disruption, reconstruction costs can constitute a significant economic drain, with money being spent on rebuilding and maintaining schools, rather than improving the education system.

Potential future costs for education related to climate change

More recent research in economics has also highlighted the potential *future* costs for education in climate-sensitive areas of Bangladesh:

'Given that, by 2050, an additional 7.08 million coastal residents would be exposed to storm surges caused by climate change, 456,690 primary school students (2,283 primary schools) and 312,957 secondary school students (2,086 secondary schools) would be at risk. Accounting for the larger extent of inundation area from a 10-year return period cyclone, an additional 4,840 primary and secondary schools would be damaged. A standard school in Bangladesh is about 160 m² and its contents worth US\$2,857 (Tk. 200,000). Assuming that half of the school walls and contents would be damaged during inundation, the estimated damage would total US\$8.96 million, and the cost of making alternative arrangements during the repair of facilities would be US\$0.82 million.' (Dasgupta et al. 2013: 18-19).

Despite the lack of detailed economic assessments of climate change impacts however, there is a **strong consensus among international aid organisations and donor agencies on the need for 'climate proofing' of education infrastructure and education systems** (See Section 4 for further information).



Impacts on learning and access to education

Existing evidence from research and practice

There is a strong and rapidly growing body of work investigating the impacts of climate and environmental change on access, attendance and quality of learning. This evidence comes from the work of international aid organisations, academic researchers and international non-governmental organisations.

Research from around the world shows the impact of climate and environmental change on children's learning and access to education, including reductions in investments in children's education, as well as decreasing enrolment and school attendance:

- A recent UNICEF report examines existing evidence around children's vulnerability to climate change, including impacts on access to education (see Lawler 2011). The review cites a range of studies in the economic and development research literature as well as studies by international organisations such as the World Bank and UNESCO. As a body of work, these highlight a range of negative impacts on education from disasters as well as incremental environmental change;
- A review conducted by the World Bank on the impact of disasters on human capital shows that household income typically falls after a disaster. The fall is greatest for already poor households. The effects of reduced household expenditure include a decline in investments in children's education (Baez et al. 2010: 8);
- Similarly, the increased incidence of droughts or flooding can have a significant impact on school enrolment and access to education (see Case Study 1).
 - A study on school enrolment in rural areas of India found that a 10% decline in agricultural income due to heavy rainfall led to an average decline in school attendance of five days (Baez et al. 2010: 15);
 - A sustained drought in 2006 in Gode, Ethiopia, also contributed to high rates of student absenteeism and dropouts, with eight out of 31 schools in the area forced to close due to high dropout rates¹.
 - Evidence from sub-Saharan Africa also shows significant effects of prolonged drought on enrolment and years in school (cf. UNESCO 2010).

Case Study 1 Schools for pastoralist children

Drought in Kenya in 2010 left an estimated 4 million people in need of emergency food aid, with pastoralist areas among the worst affected. The loss of livestock herds resulted in rising child malnutrition and also reduced access to education. As herders were forced to travel farther and farther in search of water for their animals, children were often expected to spend more time looking after the smaller animals and collecting water for home use, and were therefore forced out of school.

The drought added to existing barriers to education among pastoralist children in Kenya. This included ambivalent attitudes to schooling from many parents and village elders, partly because of the trade-offs they face between having a prosperous herd and having educated children. This tension is further exacerbated because education infrastructure – based on schooling in a fixed context and at fixed times – is in conflict with pastoralists' need to follow herds over large areas. Resolving the dilemma requires more flexible and mobile ways to provide education, particularly as pastoralist groups are under increasing pressure from climate-related environmental change.

Excerpted from UNESCO (2010: 178)

¹ See http://www.unicef.org/infobycountry/ethiopia_34733.html.



Impact on girls' education

Climate-related shocks and pressures can have particularly negative impacts on girls' education. For example, research in India concluded that women born during flood years in the 1970s were 19% less likely to have attended primary school (UNDP 2007).

Interrupted/reduced access to education will also likely have a detrimental impact on learning outcomes, reducing the likelihood that children and young people – and especially girls – will be able to break the cycle of poverty (cf. Elimu Yetu Coalition 2005). As the 2010 Education for All Report notes:

'Household poverty goes hand in hand with vulnerability. Even a small economic shock caused by drought, unemployment or sickness, for example, can force parents into coping strategies that damage children's welfare. Girls are often the first to feel the effects. In Pakistan and Uganda, climate-related shocks result in far more girls being taken out of school than boys' (UNESCO 2010: 10).

Impact on cognitive development and broader development goals

A further concern is the impacts that deteriorating livelihoods will have on nutrition and parasitic burden, and thus on learning and broader development goals. Estimates already suggest that 200 million children under the age of five fail to reach their potential cognitive development because of poor health and nutrition. These children predominantly live in South Asia and sub-Saharan Africa – the regions to be hit most hard by climate change. For example, research on under-fives in Ethiopia and Kenya suggests they are 36% (Ethiopia) and 50% (Kenya) more likely to be malnourished if they were born during a drought (UNDP 2007). Recent DFID-funded research further notes:

'...there is strong evidence to suggest that school-aged children who suffer from protein-energy malnutrition, hunger, or who lack certain micronutrients in their diet (particularly iron, iodine or vitamin A) or who carry a burden of diseases such as malaria, diarrhoea or worms do not have the same potential for learning as healthy and well-nourished children, and that they are more likely to repeat grades, drop out early and fail to learn adequately due to poor attention, low motivation and poor cognitive function.' (CREATE 2008)

This loss of human potential is estimated to lead to a 20% decrease in adult income and so has broader implications for national development (Grantham-McGregor et al. 2007). Such long-term effects have also been highlighted by research which shows that when children are born in a drought year or experience malnutrition early in their lives, the effects can be seen a decade later in their health and nutritional status, and their educational attainment (cf. Alderman et al. 2006; Alderman et al. 2009).

Impact on school attendance as a result of health impacts

Changing patterns of disease, water and food insecurity, vulnerable shelter and human settlements, extreme climatic events, population migration, and the expansion of vector-borne diseases as a result of climate change (Costello et al 2009: 1693) will have dramatic impacts on health and livelihoods, as well as access to education and learning. Malaria, for instance, has a significant impact on school attendance. It reportedly accounts for a loss of 11% of school days for primary and 4.3% of secondary students in Kenya, while in Senegal malaria accounted for 36% of all absences during the high transmission season (Jukes et al. 2008: 41-42). The impacts are not confined to students alone, with the disease also impacting on teacher attendance. Moreover, as Jukes et al. (2008) suggest, the impact of malaria on learning is likely to be amplified by the cumulative effect of absences resulting from repeated bouts of the disease over several years. The



potential impacts of malaria on learning alone are brought into sharp focus by the IPCC's estimate that the global additional population at risk of malarial infection as a result of climate change is between 220 and 400 million².

² See http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch8s8-4-1-2.html.



SECTION 3

The role of education in addressing environmental and climate change: evidence from research

It is widely agreed that a lack of education is a part of the definition of poverty, and that the provision of education is a means to reduce it. The achievement of universal primary schooling, greater levels of participation in post-primary education and training, and improved access for girls and other vulnerable children are critical to long-term improvements in productivity, preventive health care, the empowerment of women and reductions in inequality. While the impacts of climate and environmental change are likely to make this even more challenging, education can play a vital role in addressing environmental and sustainability concerns.

Approaches and definitions

Since the 1960s, a **large and very strong body of educational research has sought to understand the links between education, environment and development.** This includes work carried out using various terms and definitions, including ‘environmental education’, ‘education for sustainable development’ and many others (cf. Scott and Vare 2008; Sterling 2001; Palmer 1999). While the terms ‘environmental education’ and ‘education for sustainable development’ (ESD) are the most commonly used within the research literature, there is also an emerging body of work looking specifically at ‘climate change education’, although international debate regarding the usefulness of this term is ongoing (cf. Blum et al. 2013). This research is linked to a large international body of policy and practice supported by government agencies, international and locally based NGOs, and the international community.

The concept of ESD, for instance, emerged in the late 1980s alongside international discussions of environmental protection and sustainable development. It was given much of its shape at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, and in the resulting Agenda 21:

Education, including formal education, public awareness and training should be recognised as a process by which human beings and societies can reach their fullest potential. Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. While basic education provides the underpinning for any environmental and development education, the latter needs to be incorporated as an essential part of learning. (UNCED 1992: section 36.3)

ESD continued to receive international attention through the UN Decade of Education for Sustainable Development (2005–2014) aiming to integrate the principles, values and practices of sustainable development into all aspects of education and learning (UNESCO 2006).



In practice, programmes in education institutions can range from ‘hands-on’ activities such as recycling and waste reduction, water management, conservation and school gardens, as well as including environmental and sustainability topics within curricula at all levels of education. In particular, there is a strong body of research literature that provides evidence of the value of ‘whole-school’ approaches to education and sustainability (see Henderson & Tilbury 2004 for an international review). These approaches are designed to integrate classroom learning with daily life/practice. Programmes are also commonly organised by educators within conservation areas and as part of wider adult and community education efforts.

Evidence of impact

Within this substantial and well-respected body of international research and practice, there is ample evidence that educational programming can have an impact on knowledge, behaviours, attitudes and skills related to environmental management and sustainable development (cf. Wals 2007; Rickinson 2001; Dillon et al. 1999; Palmer et al. 1999). There has also been some recent research specifically exploring the links between education and resilience (cf. Sterling 2010; Tschakert and Dietrich 2010). While much of this work has historically been located within industrialised nations, there is a growing body of evidence from research and practice in the Global South (cf. Bull 2013; Ongare et al. 2013; Salem 2012; Collins-Figueroa 2012; González-Gaudiano 2007; Lozt-Sisitka 2004; Kwan and Lidstone 1998; Bekalo and Bangay 2002; Gadgil 2012).

This educational research is further supported by emerging evidence from the field of economics, which has illustrated that education can help people to not only build and protect social capital in general, but also to understand, cope with and respond to environmental and climate change (cf. Bowen et al. 2012; Toya and Skidmore 2007). This finding is particularly strong for the education of women (cf. Wheeler et al. 2010).

Quality matters

A large and strong body of research shows that the simple provision of basic facilities and increased enrolment does not alone ensure positive educational impacts. Rather, access must be meaningful; in other words, characterised by high attendance rates, progression through grades with little or no repetition and learning outcomes which confirm that basic skills are being mastered (cf. DFID-funded research by Lewin 2007). Furthermore, education provision is likely to be more meaningful, and participation in learning processes more active, when programmes deliver knowledge and skills relevant to local contexts and needs. In this sense, educational responses to climate change overlap with existing international development efforts aimed at the provision of **quality** education:

‘Quality education and education for sustainable development seek to achieve similar learning outcomes – those that enable learners to make decisions and choices that foster sustainable development – and are thus complementary.’ (Pigozzi 2007: 27).

Rather than representing an entirely new area of policy and practice, educational responses to environmental and climate change therefore share many of the key concerns of international education and development efforts more broadly, and particularly the need for quality education which develops human potential to address future change and challenges.



SECTION 4

Key issues in responding to environmental and climate challenges

The unpredictable nature of environmental and climate change underscores the need to build resilience, knowledge and skills through and within education systems.

This section explores five themes that are key to an education response:

1. Building 'climate resilient' education infrastructure;
2. Considering climate and environmental change within education systems planning;
3. Key areas of knowledge and skills for education;
4. Approaches to teaching and learning in formal education; and
5. The role of nonformal/community education.

1. Building 'climate resilient' education infrastructure

Planning and design responses

There is a clear need to make education infrastructure 'climate resilient' both in terms of new development as well as 'building back better' after a disaster, particularly as this can have multiple development benefits. This is a key policy and development challenge. There is a small but growing body of literature in planning which has begun to explore these issues and their importance for the field (see Davidson and Lyth 2012 for an excellent review). For example, attention to the siting and design of educational institutions can deliver multiple benefits, including buildings which are cheaper and more environmentally friendly to build, operate and maintain and are safer and more resilient in the face of environmental impacts. Building operation and maintenance costs can be a huge burden on educational systems. The use of natural ventilation, self-cooling and natural light can have a strong impact on reducing these, as well as avoiding the greenhouse gas emissions associated with more 'traditional' designs. Low carbon design of education infrastructure can also have multiple environmental and social benefits. The use of more fuel-efficient cookstoves for the preparation of school meals, for example, can have a positive impact on the environment as well as on health. Educational institutions that provide safe sanitation and water catchment facilities can also act as important resources and models for local communities.

Educational infrastructure can be better prepared to respond to environment and climate change impacts, and can reduce its own impact through careful design and planning, including:

- **School location** – assessing potential environmental and climate risks and locating new schools accordingly;
- **School design:**
 - Designing new schools to withstand extreme weather events (e.g. cyclones, tornados, flooding) as well as incremental change (e.g. school/community water catchment systems);



- Incorporating design elements which create improved learning environments (e.g. lighting, sanitation facilities and spaces conducive for learning);
- Constructing new schools in a way that minimises environmental impacts (e.g. by using locally-appropriate materials) and incorporates elements of 'green' school design (e.g. rainwater harvesting, solar lighting, biodigesters, clean cookstoves, minimising waste, school gardens with composting) (**see Case Studies 2 and 3**);
- Where possible, designing schools to accommodate changing numbers of students, and changing student needs, as a result of forced migration.
- **School energy use** – incorporating energy conservation strategies such as more efficient lighting, insulation and alternative sources of power (e.g. solar);
- **School improvements** – upgrading older schools to address potential risks and to provide improved learning environments (see above);
- **Transportation** – planning and designing transportation links (e.g. roads, public transport) to minimise disruption from extreme weather events or incremental change.

While the examples above refer specifically to schools (which often constitute the bulk of educational infrastructure as a whole), they are also applicable to other educational institutions, including sites for further and adult education, higher education and community/nonformal education.

Case Study School construction to minimise environmental impacts

Danida has over the years included environmental education in many of its programmes. In Bhutan, traditional building technologies demand high consumption of sand, stone and timber. It takes almost 3 years to complete a full traditional school in remote areas, which plays a determining role in the rate of increase of access to schooling.

In 2003, Danida consultancy services helped devise alternative construction methods for schools, which led to the pilot phase of the new light gauge steel frame construction technology, which is now being used for the construction of World Bank funded schools under the Education Development Project. It is estimated that the technology will lead to a 25% reduction in timber usage compared to traditional designs. Stone and sand requirements will also be reduced, with the need for stone and sand quarries being considerably reduced as a result. Excavation work will be greatly reduced, as the new buildings will be only 10% of the weight of traditional classrooms. Construction time will be 33% of the average normal time. The implementation of the new technology will also employ over 200 specially trained Bhutanese graduates from the National Technical Training Authority.

Source: Danida and Royal Government of Bhutan (2003)



Case Study 3 Climate resilient school design

The redevelopment of Redhill School, Worcestershire is one of the first in England to have a climate change impact assessment carried out from the start of the design process. The £2.7 million project involves a replacement primary school on the site of the former 1960s building. The school aims to have a low carbon building that is able to cope with climate change and will provide a comfortable teaching environment over its lifetime. Although located in the UK, the initiative has lessons that are clearly transferable to a range of diverse national contexts.

Some of the adaptation features of the school to help it to withstand climate change impacts include: (i) a sustainable urban drainage scheme using swales, ponds and underground box storage; (ii) a rainwater harvesting scheme, used for flushing toilets, takes rain from approximately half the roof area. Other roof areas have a planted roof finish (sedum) to reduce run-off; (iii) extra shade for pupils and teachers, provided by overhanging eaves and external canopies to the classrooms; and (iv) zinc sheet roof coverings, with standing seams, that may be less vulnerable to high winds than roofing tiles.

Excerpted from [DEFRA](#)

Wider impacts through design

Educational spaces designed with attention to environment and climate change can have a significant practical impact on wider resilience. The efficient use of water resources, effective sanitation and the development of disaster risk reduction strategies in schools, for instance, provides students with opportunities to directly engage in the management of school infrastructure as well as to consider the broader benefits of those activities through their academic studies. Similarly, educational institutions engaging students in food production, farming and animal husbandry activities can not only work towards self-sufficiency within their own operations, but can also teach key skills for sustainable livelihoods.

These efforts are particularly significant because there is evidence that young learners can play a role as catalysts for inter-generational learning within communities (cf. Ballantyne et al. 2006). Programmes in schools can therefore have a significant influence at the wider community level:

‘Programmes for harvesting rainwater can be integrated into schools so that children have a safe and ready supply of drinking water and basic sanitation facilities at school. School-based water and sanitation programmes also have the benefit of encouraging parents and the community to support children, especially girls, going to school. Such schools are not only a contribution to sustainable development itself, but also contribute to the ‘whole school approach’ as they act as a resource and good practice model for teaching and learning about sustainability and sustainable consumption.’ (Anderson 2012: 196)

Low carbon technologies

The introduction of low carbon technologies can have positive impacts on education as well as wider community benefits. A recent initiative by DFID Nigeria, for instance, is exploring the potential of solar lighting schemes in schools in order to increase girls’ access to education and as a source of future employment (see **Case Study 4**). A similar project in India has equipped schools with solar-powered battery chargers. If parents want light at night, they must send their child to school to charge the battery for a lantern. The school covers the cost of the chargers, while the household solar-powered lights are financed



separately. The initiative has resulted in higher school attendance rates, and also allows children to study in the evening³.

This kind of learning can have significant future benefits in terms of supporting long-term community resilience to climate and environmental change, and is therefore worth attention and investment.

Case Study 4 DFID Nigeria's Education Sector Support Programme

The dry-lands of Northern Nigeria present many environmental challenges, chief among which are deforestation and soil degradation. Between 2000 and 2010, Nigeria lost 3.7% of its forest per year, partly as a result of firewood being used for fuel: 110 million Nigerians currently use firewood for cooking. Increased demand for farmland and pasture has also placed a significant strain on the land. To date, 315,000 km² of Nigeria's productive landmass has been lost to desert.

Basic education is essential to ensure land and forest is conserved for building adaptive capacity to climate extremes in Nigeria. Schools provide a space for the delivery of climate change education, both formally via the curriculum, and informally as a hub of information and activity involving the wider community. DFID Nigeria's education programmes aim to strengthen people's adaptive capacity in this way. For example, the Education Sector Support Programme in Nigeria (ESSPIN) aims to have widespread impact on climate change resilience, mitigation and adaptation.

ESSPIN focuses on knowledge, leadership and innovation. The *knowledge* strand engages students, the media and teachers to build awareness of climate change issues and foster local communities of practice. This includes the integration of climate change awareness into science, maths and language lessons for primary schools. The *leadership* strand engages students and faith leaders to champion environmental issues, focusing on rainwater harvesting or grey water run-off irrigation schemes. And finally, the *innovation* strand develops and promotes pilot schemes for sustainable resource use, in collaboration with School Based Management Committees (SMBCs). One idea is for schools to become the base for a fair-price water selling operation, generating income for reinvestment in the school.

Another programme that has taken this approach is Educating Nigerian Girls in New Enterprises (ENGINE), funded by DFID through the Girls Education Challenge. ENGINE is embracing the potential of solar light in partnership with d.light solar, an affordable and environmentally friendly way to extend learning opportunities. Girls can study at home after dark and schools can be illuminated into the early evening. As well as benefitting directly from using the lights, the girls will subsequently continue to benefit when they graduate from school and are able sell solar lamps in their communities.

Source: DFID Nigeria

³ See <http://www.trust.org/item/?map=for-profit-solar-enterprises-bring-light-to-millions/>.



2. Considering climate and environmental change within education systems planning

Efforts to increase the climate resilience of communities and of educational infrastructure will need to be addressed as part of long-term planning for education systems. This will need to encompass both planning for infrastructure development and improvement as well as strategies for ensuring access and quality learning in the face of environmental and climate change impacts (see **Case Study 5**).

Accounting for extreme weather events, incremental environmental change and seasonal shifts

As outlined above, new schools and education institutions will need to be located in areas of low risk and designed to withstand both extreme weather events (e.g. cyclones, tornados, flooding) as well as to account for potential incremental environmental change in the long term. Possible seasonal shifts that occur as a result of climate change will also affect the education system, as seasons have shaped the timing of the school year in most countries. In addition, key processes in the management of educational provision have evolved to accommodate known seasonal patterns. These include:

- The timing and duration in which school building and maintenance is practicable;
- The examination cycle;
- Textbook distribution; and
- Disease incidence (and by implication school attendance), which is known to follow seasonal cycles.

Given the significance of seasonality in many developing countries, school systems will therefore need the capacity to align with changes to seasonality. Countries with significant regional climatic differences will also need to consider the benefits of decentralised decision-making about the timing of key education dates and processes.

Case Study 5 DFID Bangladesh Primary Education Development Programme 3 (PEDP3)

PEDP3 is one of the most ambitious primary education programmes anywhere in the world, aiming to provide 42,251 additional classrooms using a programme investment of 48.85 billion Takas (UK£389 million). An additional investment of 11.48 billion Takas (UK£91.5 million) is being made into water, sanitation and hygiene (WASH) facilities and furniture across thousands of sites. The programme is being funded jointly by the Government of Bangladesh's own resources and nine development partners (including DFID).

A DFID-supported study was undertaken in April 2014 to advise senior staff at the Directorate of Primary Education about the efficiency of physical infrastructure being built within PEDP3 and how it can be further enhanced. The core requirement is for infrastructure that is 'child-friendly, resource-efficient and green to build, operate and manage over the entire life-cycle; resilient to natural disasters providing a better fit for the specific requirements of the users and enhancing learning and teaching practice'. Investment in each new building or classroom should therefore aim to generate the maximum amount of 'high quality learning space'.

The study applied a simple Costs, Usable Area and Site planning (CASp) framework for capturing the efficiency of the infrastructure in progress. The framework gives attention to construction costs, net usable area, site planning (including climatic design to minimise thermal stress and provide adequate natural lighting), maintenance costs and availability of



adequate human and material resources, skills and tools. Findings of the study included the need for greater attention to and support for site planning, including issues such as classroom design and orientation, insulation and local access to basic information (such as local wind direction) and tools (computer aided simulation) for planning. It also found noticeable variations in the costs of construction and maintenance between different regions of the country, as well as a need for higher investment in quality monitoring and assurance in many areas.

Source: Kalra et al. (2014)

Planning for population displacement and migration

Education systems will need to plan for increased population displacement as a result of both natural disasters and incremental environmental change. This includes planning and supporting teaching and learning in schools affected by in- and out-migration. The need to respond to rapid changes in school populations (e.g. assessing the potential for forced in- and out-migration of student populations and planning for the resulting changes to school size and requirements) as well as the changing needs of students (e.g. language of instruction) will be central. This could include both provision of transferable skills and qualifications for those forced to migrate, as well as the development of cross-cultural awareness and understandings of the causes of migration in receiving communities and schools in order to ease potential social conflict. Students and parents affected by forced migration are also more likely to require psychological and social support to cope with the transition to a new area and to establish healthy and sustainable livelihoods (cf. Save the Children 2008; Urbano et al. 2011).

The scale of such events could range from ‘short-term’ population displacement resulting from extreme weather events to wholesale international population movements associated with the inundation of low lying islands. The need to respond to periodic forced in- and out-migration of student populations who are displaced by extreme weather events also suggests the need for ‘portable schools’ and/or schools in ‘buffer zones’ capable of accommodating expanded numbers of students at short notice.

3. Enhancing key areas of knowledge and skills within education

Addressing climate change and promoting sustainable development more generally, requires the promotion of some key areas of knowledge and skills, which are outlined in this section. These are needed at all levels (primary, secondary, tertiary and adult education) as well as via diverse modes of delivery (formal, nonformal, professional development). Climate-specific know-how and information are significant not only in schools, but are also key to adult and community education. This can be a powerful tool in increasing the resilience of both individuals and communities. For instance, farmers with access to accurate information are likely to make better management decisions (for example, by choosing crop varieties that are less dependent on volatile rainfall) and also to use insurance as a risk mitigation tool (Bowen et al. 2012: 100).

There are likely to be a wide range of specific topics and content areas which are needed to address climate/ environmental change and impacts, and needs may vary significantly depending on particular contexts. **An indicative outline of relevant knowledge and skills include the following key topics and content.**



Knowledge of global climate change and wider environmental processes

Specific subjects in this topic may include:

- Content-based science knowledge (e.g. key concepts such as climate, deforestation, habitat loss, the water cycle, soil erosion, air pollution);
- Awareness of key strategies for addressing pressing environmental and climate concerns (e.g. encouraging low carbon development, reducing deforestation and forest degradation through sustainable forest and natural resource management, improving water and waste management).

These 'big picture' areas of scientific knowledge and international strategies may be particularly relevant to professionals in areas which are directly impacted by climate and environmental change (e.g. agriculture, environmental management, health, infrastructure) in order to support effective national policy, research and initiatives.

Knowledge of local environmental and climatic conditions, associated risks and management strategies

In addition to the core topics outlined above, more locally relevant knowledge will be required. This will be highly context specific. Possible topics might include:

- Local climatology and weather patterns (including e.g. the rainy season, the annual local flood cycle) and their impacts on livelihoods;
- Assessment of locally-appropriate coping mechanisms and adaptive strategies to deal with climate variability and change;
- Identifying sources of environmental pollution and resource degradation in the area and potential strategies to address them (e.g. through improved water, soil and waste management, more sustainable practices in agriculture sustainable forest management);
- Creating awareness about the importance of biodiversity (including local endemic species); and ecosystem services for the local context

Particular attention should be given to **local and indigenous knowledge** of local environments and of management strategies that may already have proven successful in specific contexts. The validation and respect for indigenous and local knowledge can also be a vital part of ensuring relevancy and quality in education. Identification of the most appropriate issues and area of knowledge will therefore require cooperation between local, national and international actors, as well as potentially some capacity-building initiatives.

Disaster risk reduction and adaptation to climate change

Disaster risk reduction supports communities to identify and plan for emergencies linked to natural disasters and other environmental risks. These may include flooding, water contamination, soil erosion, deforestation (leading to landslides) and disease resulting from inappropriate waste disposal. Other key areas of disaster risk reduction include identifying 'safe zones' within communities during natural disasters (schools are increasingly used for this purpose) and where to go for help and assistance. Recent research suggests that these participatory strategies can have a considerable impact on community health and well-being⁴.

⁴ See, for example, work by the [Children in a Changing Climate](#) initiative.



Disaster risk reduction has received increasingly strong support within international policy, but needs to be better integrated with adaptation to climate change. The *Mid-Term Review of the Hyogo Framework for Action* in 2011, for instance, identified the integration of climate change adaptation and disaster risk reduction as a necessity that must be addressed at the national and local levels (UNISDR 2011: 10).

Education can play a key role in fostering this integration by enhancing knowledge on disaster risk and climate change and by enhancing learners' confidence and willingness to act (**see also Case Study 6**):

'Informed understanding, honed by reflection and fostering confidence and a disposition to take action, is vital for tackling a resigned or fatalistic view of natural disasters. Students need to understand that the level of disaster risk is a factor of the nature and degree of the hazard combined with the degree of vulnerability but that the risk can be significantly reduced according to the community's ability to cope. Such understanding enables them to more readily assume a proactive and positive mindset towards resilience building in their own communities. Understanding and attentiveness to both climate change and disaster risk are also vital given the significant level of uncertainty surrounding both' (Kagawa and Selby 2012: 212).

Case Study 6 Children as agents of change for disaster risk reduction

While a growing number of development approaches focus on reducing the risk of disasters, they tend to treat children as passive victims with a limited role to play in communicating risks or preventing and responding to disasters. Recent research suggests, however, that children in developing countries are making significant contributions to minimising disaster risks.

When the Mines and Geosciences Bureau (MGB) conducted a risk assessment of landslides in Southern Leyte, Philippines in 2006, it determined that eight districts, two of which were home to a high school and an elementary school, were at significant risk. Following debates about whether and how to relocate the school, the headmaster opened the decision to a communitywide referendum to include a vote for each of the children of the school. Broadly, the children were in favour of the relocation, and their parents against it, because the parents were concerned about their children having to travel to school in a different community and the loss of livelihoods associated with the relocation of a school (e.g. loss of lunch business for local shops, as well as loss of political power generated from having an education facility based in their district).

In addition, different political affiliations of the leadership in the two districts led to confusion over the exact detail of the risk communication from the MGB, with opposing politicians highlighting contrasting interpretations to their supporters. The children's organisations in the school embarked on an education campaign about the physical processes of landslides and large numbers of students wrote to the School Division Superintendent expressing their desire to relocate. The actions by the students helped them to win the vote by 101 to 49, signalling the relocation of the school.

Due to concern from the Provincial authorities, a more protracted timetable for the school's relocation was shortened to just two days following heavy rains. A temporary tent school was erected over one weekend with children and parents helping to put up the tents and children digging drainage channels due to the temporary school's location close to a paddy field. The tents, water supply and toilets were provided by Plan Philippines, along with a scholarship programme helping poorer students to afford uniforms and school supplies. The children reported feelings of excitement about the whole process and did not express any regret about the decision to move. They did report difficult conditions in the temporary school,



particularly the heat in the tents, though the children helped to line the tents with banana leaves to cool them. In 2007, a new school opened in Pasanon, a safer location a few hundred metres from the temporary school. The new school includes earthquake mitigation measures such as steel ties on the roof. Toilets have also been built in each classroom in order to prepare for its use as an evacuation shelter.

Excerpted from Mitchell et al. (2009: 30)

Health risks associated with climate change

Human and environmental health are strongly linked, and attention to both is key to sustainable development efforts. In addition to the continuing need for health education programmes which address specific health concerns (e.g. HIV, malaria, maternal health, vitamin deficiencies, malnutrition), there is also a need to link these concerns to climate change and to local environmental factors in order to prepare individuals and communities to cope with their impacts. Topics of concern (see Costello et al. 2009: 1693) include:

- Changing patterns of disease;
- Water and food insecurity;
- Vulnerable shelter and human settlements;
- Extreme climatic events and;
- Population growth and migration.

Educational initiatives that include attention to these impacts of climate change on health are likely to result in improved health outcomes, as well as the greater resilience of individuals and communities more generally.

Integrating key knowledge and skills into education systems

Opportunities for integrating these key areas of knowledge and skills should be exploited in the curriculum renewal process. Rather than requiring the provision of entirely new, separate, curriculum subjects, however, they can be integrated into teaching in existing curriculum areas, particularly in the natural sciences, geography (**see Case Study 7**), social studies (especially related to local community and culture), and professional education (cf. Vize 2012; Bourn and Neal 2008).

Tailoring the provision of knowledge and skills to the needs of different learners

The ways in which these themes are included in educational programmes will vary according to needs of learners of different ages and levels of existing knowledge:

- **Primary level:** the emphasis is likely to be on developing basic environmental knowledge, encouraging the value of sustainability and providing opportunities for 'learning through doing'. An important caveat here is that educational efforts should be careful not to overwhelm young learners with messages that might be frightening or full of 'gloom and doom', which can be disempowering;
- **Secondary level:** there can be greater movement towards the development of more specialist/detailed environmental knowledge and critical exploration of ideas, often as a link to aspirations for the future, including career plans;
- **Tertiary level:** the emphasis is likely to be on further deepening specific areas of knowledge and skills such as problem solving and critical thinking (e.g. in professions such as agriculture, engineering, health). DFID's work in this area has included the Higher Education Links scheme (1981-2006) and the Development Partnerships in Higher Education programme (2006-2013) in partnership with the British Council and



the Association of Commonwealth Universities. The latter programme, which supported more than 114 partnerships over its lifetime, aimed to build and strengthen the capacity of higher education institutions in DFID's priority countries to: contribute towards the MDGs (especially MDG 1, 6, 7 and 8); promote science and technology related knowledge and skills; influence relevant national policy and practice; and build academic and research capacity at an institutional and individual level (DFID 2013).

Case Study 7 Promoting spatial thinking in natural resource management, Rwanda

Spatial thinking skills are under-represented in Rwandan upper secondary education. A two-year project starting in 2013 aims to address this challenge by creating a science and technology curriculum for natural resource mapping experiences. Teachers and students will be trained on using tablet computers and smartphones for performing mapping projects with geographic ICTs. The project will leverage the mobile phone network in Rwanda, helping to connect students and teachers to the environment in their districts. In doing so, it will support the use of new technologies in education as well as increasing students' and teachers' awareness of local environmental and climate change issues.

Anticipated project outcomes include:

- Students show increased spatial thinking ability as evidenced via mean test scores.
- Students show improvement in knowledge of geographic ICT concepts.
- Teachers can incorporate geographic ICTs into their teaching practice to supplement the earth science curriculum.
- New open source geographic ICTs are created for use in Rwanda.

The project is one of 26 Innovation for Education projects, a partnership between the Ministry of Education and DFID. All of the projects focus on improving the quality of education within one or more of six thematic areas central to Rwanda's education strategy: accountability and empowerment; inclusive education; climate change and environment; effective teaching and learning; skills development; and use of appropriate technologies in education.

Source: [Ministry of Education, Rwanda](#)

Increasing professional and technical knowledge

A number of international organisations have noted a particular shortage of professional level skills and knowledge related to climate change. As the World Health Organisation recently said: 'Effective adaptation will require individuals skilled at recognising, reporting and responding to health threats associated with climate change. Lack of trained and skilled personnel may restrict a nation's ability to implement adaptation measures' (WHO 2008: 229). Such efforts are important given the chronic shortage of scientific knowledge and expertise around climate change and its impacts in many developing countries, a particular concern for educators and policy makers at both secondary and tertiary levels. As an OECD study reported in the 2009 EFA Global Monitoring Report stated:

'The PISA 2006 assessment of scientific literacy among 15-year old students offers some important lessons.... Strong performance in science and awareness of global environmental problems tend to go hand in hand, and both are associated with a sense of responsibility supporting sustainable environmental management. Conversely, weak performance in science is associated with lower awareness of environmental problems. Failure in scientific education will mean less widespread –



and less informed – public debate on issues such as climate change and wider environmental problems’ (UNESCO 2009: 37).

DFID has sought to build awareness of global and development issues at a professional level in the UK. The aim is to prepare new graduates with the knowledge and skills to contribute to international development. The [‘Students as Global Citizens’](#) project, funded by the Development Awareness Fund (2009-2012), aimed to develop and evaluate methods to embed learning about global and development issues within degree courses on pharmacy, veterinary science and human health (see Willott et al. 2012; Maud et al. 2012; Murdan et al. 2014). The work recognised the important contributions that professionals in these fields make to international development by improving human health and livelihoods, for example, by preventing and treating infectious diseases and improving the health of livestock. These improvements can in turn have other positive effects, including increased access to education, reduced infant mortality, reduced fertility, improved child nutrition and reduced rates of HIV infection. As of yet, however, coverage of development and global issues in professional degree programmes globally is very limited.

4. Improving approaches to teaching and learning within formal education

The evidence from research and practice is clear: educational programmes need to not only include key areas of knowledge and skills, but also to focus on quality of teaching and learning.

Understanding learning

Education responses to climate and environmental change need to support learners to develop the knowledge, skills and capacities that will enable them to think critically, to solve problems, and to address uncertainty – all of which are key to addressing climate change and sustainable development, and to living in a rapidly changing world more generally.

Early efforts in environmental education advocated the addition of environmental topics to educational programmes on the assumption that access to this information would inevitably lead to behavioural change. The evidence from educational research, however, now strongly refutes this linear correlation and argues that such an understanding of learning (e.g. input = change) is far too simplistic. This includes work from research on learning in general (cf. Illeris 2007; James et al. 2007), as well as environmental learning specifically (cf. Wals 2011; Kagawa and Selby 2010; Krasny et al. 2010; Heimlich and Ardoin 2008):

‘Using *behaviour change* as a primary focus in discussing environmental education suggests that behaviour change is being thought of as a primary educational goal. But maximizing ‘pro-environmental behaviour’ is not a goal that any educator adequately familiar with post-1950s educational research could accept. It suggests a behaviouristic approach to education, bypassing students as thinking beings and young citizens capable of making their own decisions about *what constitutes* ‘responsible environmental behaviour’—and needing help in developing the skills and dispositions that will enable them to make these decisions well. In contrast, the importance of focusing on such outcomes as critical thinking and action competence rather than on ‘environmental behaviour’ has been a steady theme in educational research’ (Courtenay-Hall and Rogers 2002: 284-285; original emphasis).

This discussion includes not only educational efforts in schools, but also in other educational arenas, including higher education:



If we are secure in our estimation of the worth of what we already know, and clear about what we want to happen next, then we can certainly decide what the next generation needs to know, and universities can teach it to them. On the other hand, if we recognise and acknowledge our human failures, and are nervous about the future, then we need universities to prepare a generation that will understand, and act, better than any of us presently do (Gough and Scott 2007: xi).

Developing effective teaching approaches

Climate change interventions in education must therefore seek holistic ways of addressing climate change through appropriate approaches to teaching and learning.

If the role of education is to help learners of all ages to develop the knowledge, skills and capacities that enable them to think critically, to solve problems, and to address uncertainty, this must be reflected. Strategies such as: *activity-based and problem-based learning, and techniques such as case studies, simulations, role playing and group discussions*⁵, for instance, actively engage pupils in the process of:

- i. Identifying issues;
- ii. Investigating them;
- iii. Seeking solutions;
- iv. Carrying out action and;
- v. Evaluating impact.

These strategies encourage learners to develop critical thinking and problem-solving skills, as well as a deeper understanding of the complex and multidimensional nature (social, economic, political, historical) of climate and environmental change.

Learning and skill development of this kind is more effective when supported by appropriate approaches to assessment. Assessment can have significant positive and negative impacts on what happens in classrooms (cf. James et al. 2007; Vulliamy 1988). Standardised testing, for example, which requires students to show mastery of particular curriculum content is likely to lead educators and learners to rely on memorisation and rote learning (i.e. teaching to the test), rather than to use activities which develop critical thinking or problem-solving skills.

The potential benefits of such an approach are likely to be widespread. They may include: increased access and completion levels, as well as the encouragement of critical thinking and lifelong learning skills needed to address climate change and future uncertainty. These include ‘learning to know’, ‘learning to do’, ‘learning to be’ and ‘learning to live together’ (Delors 1996). These skills, in turn, are linked to a wide range of potential inter-connected improvements to health and well-being which have already been identified by research (e.g. reduced infant mortality, reduced fertility, improved child nutrition and reduced rates of HIV infection) and are strongly connected to core thinking in development (e.g. Sen 1999; Nussbaum 2000; Chambers 2008).

Support for teacher education

Such sweeping changes will require support to teachers to give them the necessary training and confidence to deliver quality education. Case Study 8 provides an example. This is particularly true for education about environment and climate change, which requires teachers to understand and be able to support learning which is appropriate to local environmental, social and political contexts and which meet wider educational targets (e.g.

⁵ For a detailed and critical discussion of these approaches, see Jonassen and Land (2012).



literacy, numeracy, employability). Teacher education will therefore need to focus on enhancing teachers' own knowledge and skills in key content areas and in learner centred, participatory and inclusive instruction (Anderson 2012: 195; see also Kyburz-Graber et al. 2006; Collins-Figueroa 2012; Jiménez-Elizondo 2010). This may be particularly challenging in contexts where educational practices tend to focus on methods such as rote memorisation and mastery of curriculum content.

Case Study 8 Education for sustainable development teacher training course, Costa Rica

In 2006, Costa Rican President Oscar Arias signed a commitment to implement the United Nations Decade of Education for Sustainable Development, and simultaneously created an initiative called Peace with Nature. The initiative drew together committees of experts from governmental and non-governmental organisations to propose initiatives on 12 key environmental concerns, from water resources to ecotourism.

The Education and Communication Committee, coordinated by the Ministry of Public Education, identified as one of its key priority areas the development of a teacher training course on environmental education for sustainable development. The main objective of the course was to implement training on education for sustainable development in order to generate awareness and empower participants to make decisions to solve problems in their own institution, community or region. From August 2008 to October 2009, it was implemented three times for educators and administrators from two regional management units.

The content of the course was designed to align with key topics within the National Strategy for Environmental Education. It used a highly participatory methodology, a 'learning by doing' style, which gave the participants the experience of a transformative process in their way of thinking and acting towards more sustainable lifestyles. It was envisioned that after being trained in the process, it would be easier and more natural for the participants to communicate this to their students and colleagues. To make course attendance more attractive, the Ministry of Education and Civil Service accredited the course so that participants could earn 'points' that eventually translate to salary increases.

Results from feedback surveys with participants showed that they all gave high scores (very good to excellent) to all sessions and facilitators. However, many also expressed a desire to have longer sessions for each topic, arguing that there was not enough time to grasp all the new information provided. Having more sessions and reaching out to more regional management units, however, would require an increase in the budget, so new funding sources are pressing need.

Excerpted from Jiménez-Elizondo (2010)

Teacher education institutions therefore have a key role to play in addressing climate and environmental change within formal education through:

- The education of new teachers;
- Updating the knowledge and skills of in-service teachers;
- Creating teacher-education curriculum;
- Providing professional development for practicing teachers;
- Contributing to textbooks;
- Consulting with local schools and;
- Providing expert opinion to regional and national ministries of education (cf. Hopkins and McKeown 2005)



Existing work by international organisations such as the [UNESCO Teacher Education Network](#) and the [Asia-Pacific Cultural Centre for UNESCO](#), who have significant expertise in this area, can provide important resources for such efforts (see **Case Study 9**).

Case Study 9 Teaching and learning approaches for education for sustainable development in Thailand

Around 90% of the 550 students at Bansunkong Primary School are Akha, one of the main hill tribe groups in Northern Thailand. Those attending the school have most recently settled in Mae Chan after moving from a more isolated life in the mountains located near or in Myanmar. Their families are predominantly agricultural workers or manual day labourers, with most qualifying for government subsidies for their education. Twenty per cent of the students live with guardians who are not their birth parents; 33% have lost their father and a small percentage are orphans. Many students enter school late with little or no knowledge of how to speak Thai, and most with little to no pre-school education. Despite these challenges, the school is increasingly recognised as a quality learning institution and has received numerous local, regional and national awards, including for its environmental programmes, and students earn average, and sometimes even above average, marks on national tests.

One of the keys to the school's success is use of the '7-step Method', which emphasises case-study based problem solving of local community issues as the crux of teaching and learning. Students are asked to identify various issues facing local communities, conduct research on the issue, propose possible solutions and finally, create and implement a plan of action. Since its inception with Year 5 students in 2003, teachers have noticed improved work habits, critical thinking abilities and confidence among participating students. In 2006, the school was awarded funding under the ACCU-UNESCO Asia-Pacific Innovation Programme for Education for Sustainable Development. Funding allowed the school to extend training and workshops on the method to the whole school and to receive pedagogical advice from academic officers of the Ministry of Education.

This support was fundamental in preparing teachers to apply the approach in their classrooms. Some teachers were at first resistant to the new methodology as it was so different from the way they were taught as students and also from the way they were taught to teach. Unlike traditional teaching methods where teachers learned by the text and repeatedly used the same routine lessons, the 7-step approach forced them to continue to adapt and learn new things alongside their students. Teachers are unsure what community issues their students will choose to study each year, and so they often end up learning about a new subject along with their students. 'We are constantly kept on our toes—by both the method itself and the director. It's challenging, but it's really exciting. We feel well supported and prepared to deal with these challenges. So it really becomes a triumphant sort of challenge to overcome.'

Excerpted from Guevara et al. (2012)

5. Integrating learning about climate and environment into nonformal/community education

Learning, skill development and awareness-building beyond formal education must also be part of an effective response. Certainly, the timescale in which climate change must be addressed is too short to leave this entirely to young learners who are not yet in a strong position to effect direct changes to policy and practice. Research in environmental education/education for sustainable development through community and nonformal education programmes provides a strong evidence base for the value of these efforts (cf. Dillon 2003; Wals 2007).

Opportunities for nonformal/community education can be encouraged through a range of community and professional groups and leaders. Such initiatives can help to develop



leadership in local sustainability and to build the resilience of communities effected by environmental and climate change (cf. Monroe et al. 2009; Shohel and Howes 2011). In communities where poverty is the main driver for environmentally damaging behaviours (e.g. unsustainable use of natural resources, deforestation), initiatives aimed at poverty reduction, improved natural resource management and climate resilience can have an impact on multiple development goals.

These programmes are particularly effective when they:

- i. Take a participatory approach to research and learning;
- ii. Capitalise on existing local knowledge and expertise as well as environmental management strategies which have already proven successful and;
- iii. Focus on both short and long-term concerns.

These findings mirror the conclusions of the strong body of evidence from educational research

Benefits for women and girls

Focusing community-based efforts on women and girls can have particularly strong impacts. This is especially true in communities where they have responsibility for managing natural resources for household and community use (e.g. water, wood, agricultural production). There is a strong and substantial body of research and policy which illustrates the ways in which women can be instrumental in organising themselves and their communities around environmental issues and sustainable development (cf. Dankelman 2002; UNDP 2009). Poor women are also more likely to feel the effects of environmental degradation and climate change as a result of their involvement in, and reliance on, livelihoods activities such as collecting water and firewood, which depend directly on the natural environment (Denton 2002: 12). Climate change initiatives that take gender into account can therefore have a potentially positive effect on gender equality by providing greater space for the participation of women and girls in local development and environmental management (see **Case Study 10**).

Case Study 10 Green Belt Movement, Kenya

The Green Belt Movement (GBM) is a well-known Kenyan women’s NGO that began initiatives to plant trees at the grassroots level in 1977 to tackle the problems of deforestation, soil erosion and water scarcity. The programme has since evolved into an instrument that facilitates the empowerment of women. It pursues a holistic approach. Trees (including fruit and other ‘commercial’ trees) are planted by voluntary networks of women and their families. The participants are trained in sustainable agriculture with the aim of diversifying their livelihoods and earning an income. They undergo comprehensive capacity building, e.g. in food production, processing and marketing, apiculture and the planting and care of trees – activities that aim to empower women to generate an income of their own.

The programme makes an overall contribution to climate mitigation, as emissions are hindered and absorbed because existing trees are cared for and new ones planted. A contribution is also made to climate adaptation, as the communities learn about the sustainable use of scarce resources and about sustainable agricultural techniques. And finally, the Green Belt initiative also empowers women economically, as they now have alternative sources of income created by the planting and caring of trees.

Excerpted from Bathge (2010: 10)



Community-based adaptation

There is **large and strong body of research and practice on ‘community based adaptation’** (CBA; cf. Reid et al. 2009; Nursey-Bray et al. 2013)⁶. CBA is often led by or in collaboration with NGOs and aid agencies. While this work is not always explicitly linked to educational research or practice, its focus on learning at the community level makes it highly relevant to an educational response to climate and environmental change.

International experience in CBA

DFID – The [Community-Based Adaptation in Africa](#) (CBAA) project supported by DFID is carrying out climate change adaptation pilot projects at community level in eight African countries (Sudan, Tanzania, Uganda, Zambia, Malawi, Kenya, Zimbabwe, South Africa). Communities vulnerable to climate change were selected with emphasis on the vulnerability of women. Participatory and consultative approaches are being adopted to reduce vulnerability to climate change at the community level. The project is identifying ways of communicating climate information to poor and vulnerable communities, and from communities to other stakeholders. Capacity building and support is being given to NGOs and communities through training to facilitate integration of climate change into their plans and activities. The project aims to create greater awareness of climate change, which will empower NGOs, local communities and researchers to integrate, carry out and generate information on climate change adaptation.

UNDP – UNDP’s [Community-Based Adaptation Project](#) is designed to implement community-based projects that seek to enhance the resilience of communities, and the ecosystems on which they rely, to climate change impacts. It aims to do this by supporting communities to generate knowledge about how to achieve adaptation at the local level. Ten participating countries (Bangladesh, Bolivia, Guatemala, Jamaica, Kazakhstan, Morocco, Namibia, [Niger](#), [Samoa](#) and [Vietnam](#)) have each developed, planned and implemented a portfolio of community-level adaptation projects which address locally-relevant issues⁷. The [International Institute for Environment and Development](#) has also initiated long-term research and development partnerships with researchers, practitioners and communities in Bangladesh. The programme is designed to be iterative ‘action-research’ – using a process of learning, applying lessons, and learning more – and is ‘designed to track the long and uncertain course of climate change. The ordinary one-to five-year funding cycle doesn’t allow an effective response to climate change impacts, which unfold unpredictably over 50 or 100 years. This project takes the long view, planning activities that set the stage for decades of work’.

New Economics Foundation – NEF Research has begun to build a strong economic case for the value of community based adaptation strategies. A study in Kenya showed that under the most realistic scenarios, investing \$1 in CBA generates between \$1.45 and \$3.03 of wealth for communities, and taking action by investing in community based adaptation can result in a per capita income of about \$2.1 a day, on average (Nicholles et al. 2012: 4). An evaluative study in Niger similarly suggested that for every £1 invested in CBA, returns of between £4 and £6 are likely even across a range of climate scenarios (Vardakoulias and Nicholles 2014). In the most conservative scenario, the costs of intervention were 2.6 times lower than doing nothing to counter the impacts of climate change and extreme events. In Niger, CBA was also found to increase revenue from both agricultural and livestock

⁶ See also Care International’s [Community-Based Adaptation Toolkit](#), FAO’s [E-learning Tool – Community based adaptation to climate change](#), and ELDIS pages on [Community Based Adaptation to Climate Change](#).

⁷ The work also includes attention to gender; see the [Coping with Climate Risks by Empowering Women in Coastal Areas](#) project.



activities, with communities experiencing a 40% increase on average in agricultural returns since 2010 even though productivity has not increased significantly, and livestock headcount is decreasing. Both studies also suggest a growing level of ‘adaptive capacity’ in communities through shifts in attitudes and practices, as well as decision-making processes that are more flexible and forward-looking. Alongside economic benefits, the studies also pointed to better social and environmental indicators – on improved health and education, more decision making for women and reduced deforestation and land degradation.

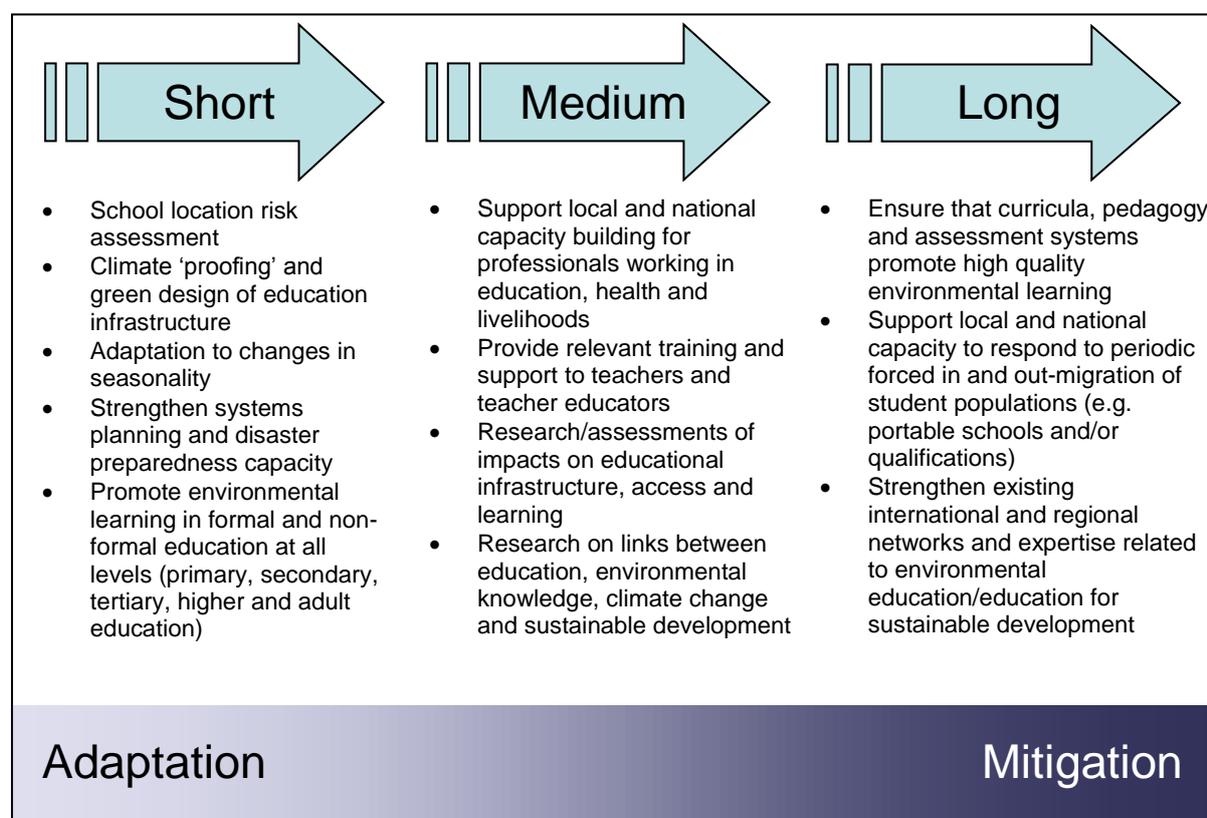
Other UN initiatives – Recent sustainability and climate change initiatives linking formal and nonformal education have also proven effective in enhancing knowledge and capacity. The UN-supported [Mainstreaming Environment and Sustainability in African Universities Partnership](#) (MESA), for instance, offered opportunities for collaborative projects among universities, governments, civil society, communities and the private sector. It aimed to help African universities integrate environment, economics, health, poverty and development into a meaningful learning experience (cf. Ogbuigwe 2008). The UNEP has since built on this experience, and its work in the Caribbean and Asia-Pacific region, to create the [Global Universities Partnership on Environment and Sustainability](#). Such networks between and among education institutions and communities can help to significantly strengthen capacity building and resilience to climate and environmental change.

SECTION 5

Integrating climate and environmental issues into education: short, medium and long term responses

In practical terms, climate and environmental change represent both immediate and long-term challenges for education systems. While the immediate challenge is to climate-proof education systems, the longer and perhaps even more challenging task is to develop education systems that equip learners with the requisite skills, knowledge and attributes to deal with future challenges. In many ways the latter is nothing new, but is at the heart of the very purpose of both education and development agendas. What has changed, however, is the nature and urgency of the challenges faced – locally, nationally and globally. Each of the elements discussed in this Topic Guide will require the development and strengthening of networks of financial and political support which can be usefully addressed in the short, medium and long term (see Figure 3).

Figure 3 Educational responses to climate and environmental change



Adapted from Bangay and Blum (2010)



Short-term responses

- **‘Climate proofing’ of educational infrastructure** – in order to minimise the risks and associated costs. This should entail careful risk assessment in making decisions about school location and improved building design/maintenance to better withstand extreme weather events as well as incremental environmental change, and to incorporate ‘green’ design elements which increase efficiency and encourage learning about environmental and climate issues;
- **Creation of sound local and national planning systems** – to encourage future planning to mitigate climate change impacts on education infrastructure as well as access and learning. This should include factoring in climate and environmental risks when choosing locations for new buildings. Changes in seasonality may also require some areas to reconsider planning issues such as the timing of the school year, the timing and duration in which school building and maintenance is practicable, the examination cycle, textbook distribution, etc;
- **Promotion of educational programmes** – encourage coverage of environmental and climate change, management strategies, disaster risk reduction, and health education in formal and nonformal education at all levels (primary, secondary, tertiary, higher and adult education). Increased attention to these issues in higher education and training for relevant professions (e.g. education, agriculture, forestry, engineering, health) is particularly important in order to build future capacity. Work at all levels of education can be done through national and local government agencies as well as through collaboration with NGOs and aid agencies already working in these areas.

Medium-term responses

- Continuing support for short-term responses;
- **Capacity building** – encourage local and national capacity building to address climate change impacts on education, health and livelihoods (especially in agriculture). This might include providing funding for the design (or re-formulation) and delivery of training programmes containing climate change topics and strategies to address them. Key target audiences for these efforts include policy makers, agricultural extension workers, health care providers, and engineers. Where feasible, regional cooperation to share knowledge and experience in this area could expedite progress and prevent duplication of efforts;
- **Support for teacher training** – support national education ministries and teacher education institutions to provide relevant training and support to teachers. This could be done by drawing on the extensive experience of international education and sustainable development stakeholders, such as the Asia-Pacific Cultural Centre for UNESCO and the UNESCO Teacher Education Network;
- **Research and assessment** – support further research/assessments of the current and potential damage to educational infrastructure, access and learning due to climate and environmental change. More of this work is needed to provide a solid evidence base for future policy and planning;
- **Case studies** – support continuing research and the development of case studies on the links between education, environmental knowledge, climate change and sustainable development. This will further strengthen the existing body of evidence and provide more examples of good practice.



Long-term responses

- Continuing support for both short and medium-term responses;
- **Curriculum development** – support national education ministries to assess existing curricula to ensure that they support high quality environmental learning. This will require attention to curriculum content (both ‘core’ environmental and local/indigenous knowledge), as well as approaches to pedagogy and systems of assessment. In many cases, this will require a move away from an emphasis on rote learning and standardised testing, and towards activity-based approaches and formative styles of assessment which help to develop critical thinking and problem-solving skills;
- **Prepare for the impacts of migration** – support local and national capacity to respond to periodic forced in and out-migration of student populations who are displaced by extreme weather events. This includes a need to respond to rapid changes in school populations (e.g. assessing the potential for forced in- and out-migration of student populations and planning for the resulting changes to school size and requirements) as well as the changing needs of students (e.g. language of instruction). Key needs could include provision of transferable skills and qualifications, as well as the development of cross-cultural awareness and understandings of the causes of migration in receiving communities and schools. Students and parents affected by forced migration are also more likely to require psychological and social support to cope with the transition to a new area and to establish healthy and sustainable livelihoods;
- **Strengthen networks and expertise** – build on and strengthen existing international and regional networks and expertise, for instance, related to environmental education/education for sustainable development, which have already made significant progress on addressing climate and environmental change within educational programmes (e.g. the United Nations University’s Regional Centres of Excellence in ESD, MESA). Existing national ESD strategies and curriculum development efforts can also be further strengthened in order to address issues specific to environmental and climate change.



SECTION 6

Challenges and opportunities

Challenges

The education response to climate and environmental change clearly poses a number of challenges for international development. This includes the need to:

- **Design interventions which give attention to specific local contexts and needs.** A ‘one-size-fits-all’ approach to programme development is highly unlikely to be useful given the complex nature of the links between the social, environmental and economic dimensions of nations and communities. There are lessons to be learned through the sharing of approaches and techniques nationally and internationally. However, it is important to recognise that what works well in one context may not work well in others due to specific local environmental conditions, diversity of available resources, local stakeholders, existing local knowledge and environmental management practices, and concerns regarding gender and other vulnerable population groups;
- **Give much greater attention to the preparation of educators at all levels to deal with the challenges of teaching and learning around climate and environmental change.** This includes not only increasing relevant knowledge, but also capacity building around the teaching approaches and pedagogies that best support high quality learning. Existing education interventions have tended to focus on curriculum revision and the inclusion of environmental topics, but have given relatively little support to educators who must implement teaching about these complex issues. Research shows that participatory and activity-/problem-based strategies are highly effective in encouraging learners to develop the skills – such as critical thinking and problem-solving – which will help them to cope with an uncertain future. Educators at all levels will need support to develop their practice in these areas, particularly in contexts where rote-learning strategies and standardised testing are the norm;
- **Ensure that the needs of women, girls and a range of vulnerable population groups are adequately addressed, particularly given their greater vulnerability to climate change impacts.** This applies to issues around access to education (and therefore to quality learning) and participation in developing climate resilience. Where these groups are responsible for the local management of natural resources (e.g. water, wood, agriculture), such approaches can potentially generate returns on multiple development goals;
- **Expand the existing evidence base regarding the impacts of climate and environmental change on educational infrastructure, access and learning.** This is a significant gap in the available knowledge that needs to be addressed in order to effectively inform future policy and practice;
- **Create and maintain high levels of engagement between international and local governments and organisations, and a range of diverse stakeholder groups.** This will be particularly challenging where there are conflicts over access to resources, fragile government structures, pressures from in- and out-migration, and existing inequality in education provision;
- **Build on and extend existing approaches and practice in related areas of development – for instance, work on disaster risk reduction, gender inequality,**



with vulnerable population groups – rather than ‘reinventing the wheel’. This kind of multidimensional working can provide higher returns on investment, but can be challenging in terms of organisation and developing effective ways of collaborative working.

Opportunities

Despite these challenges, there are also a number of existing resources and networks, and key policy linkages that can be further built upon to support future educational responses to climate and environmental change:

- **Research and policy in education, environment and sustainable development** – these areas have a long and rich history – beginning in the 1960s – which represent a wealth of knowledge and expertise on approaches to teaching and learning, curriculum development, and working with diverse communities around the world on environmental issues. The lessons learned from this research are directly applicable to educational responses to climate change, and emerging research on education, climate change and resilience represents a significant new area for future learning and development.
- **International networks of EE/ESD educators** – these rich communities of practice, knowledge and understanding can be usefully drawn upon in formulating educational responses to climate and environmental change. Tapping into this expertise can help to build local and national capacity as well as to support mutual and organisational learning. Examples of key networks include the [MESA](#) network in Africa, UNESCO schools networks, the [UNESCO Teacher Education Network](#), [Asia-Pacific Cultural Centre for UNESCO](#)'s network of ESD educators and facilitators, and United Nations University's [Regional Centres of Excellence in ESD](#).
- **Existing national ESD strategies** – As a result of the UN Decade of Education for Sustainable Development most countries now have national ESD strategies, although in many cases these have yet to be embedded or implemented. These existing policy frameworks provide important opportunities for embedding climate and environmental issues within educational programmes, and these can be usefully drawn upon and further strengthened in the future.
- **International community of DFID-funded development, educational, environmental and climate change experts and students** – This includes a number of large alumni networks which could also be drawn on for further expertise and action in their home contexts. The [UK Commonwealth Scholarship Commission](#), for instance, was established in 1959 and awards over 900 scholarships and fellowships for postgraduate study and professional development to Commonwealth citizens each year. These stakeholders and experts are well placed to provide locally relevant and culturally appropriate support and advice.
- **Wider policy linkages** – Links are also increasingly being made between international efforts in education and the environment, quality, and Education for All (cf. Wade and Parker 2008; UNESCO 2014; [Education First Initiative](#)). Although the details of the post-2015 international development agenda have yet to be fully determined, there are also clear indications that greater attention will be focused in the future on the links between education quality and sustainable development (cf. [UNESCO & UNICEF 2013](#)). The convergence of these key international agendas – and their shared objective of providing education which develops human potential to address future change and challenges – provides excellent opportunities for innovative interdisciplinary and inter-sectoral collaboration.



References

- Alderman, H., Hoddinott, J. and Kinsey, B. (2006) 'Long term consequences of early childhood malnutrition', *Oxford Economic Papers*, 58, 3, pp.450-474.
- Alderman, H., Hoogeveen, H. and Rossi, M. (2009) 'Preschool nutrition and subsequent schooling attainment: longitudinal evidence from Tanzania', *Economic Development and Cultural Change*, 57, 2, pp.239-260.
- Anderson, A. (2012). 'Climate change education for mitigation and adaptation', *Journal of Education for Sustainable Development*, 6, 2, pp.191-206.
- Asian Disaster Preparedness Center (2008) [A Study on Impact of Disasters on the Education Sector in Cambodia](#). Bangkok: Asian Disaster Preparedness Center.
- Bangay, C. (2013) 'Natural hazards in India: forewarned is forearmed' in Smawfield, D. (ed.) *Education and Natural Disasters*, London: Bloomsbury.
- Bangay, C. and Blum, N. (2010) Education responses to climate change and quality: Two parts of the same agenda? *International Journal of Educational Development* 30, 4, pp.359-368.
- Baez, J., Fuente, A., Santos, I. (2010) [Do Natural Disasters Affect Human Capital? An Assessment Based on Existing Empirical Evidence](#). Discussion Paper No. 5164. Bonn: World Bank and the Institute for the Study of Labor.
- Bahadur, A., Ibrahim, M. and Tanner, T. (2013) 'Characterising resilience: unpacking the concept for tackling climate change and development', *Climate and Development*, 5, 1, pp.55-65.
- Ballantyne, R., Connell, S. and Fien, J. (2006) 'Students as catalysts of environmental change: a framework for researching intergenerational influence through environmental education', *Environmental Education Research*, 12, 3, pp.413-427.
- Bathge, S. (2010) [Climate Change and Gender: Economic empowerment of women through climate mitigation and adaptation?](#) Working Paper, Governance and Democracy Division, Governance Cluster, Programme Promoting Gender Equality and Women's Rights, GTZ.
- Bekalo, S. and Bangay, C. (2002) 'Towards effective environmental education in Ethiopia: problems and prospects in responding to the environment-poverty challenge', *International Journal of Educational Development*, 22, 1, pp.35-46.
- Blum, N., Nazir, J., Breiting, S., Goh, K.C. and Pedretti, E. (2013) 'Balancing the tensions and meeting the conceptual challenges of education for sustainable development and climate change', *Environmental Education Research*, 19, 2, pp.206-217.
- Bourn, D. and Neal, I. (2008) [The Global Engineer](#). London: Engineers Against Poverty.
- Bowen, A., Cochrane, S. and Fankhauser, S. (2012) '[Climate change, adaptation and economic growth](#)', *Climatic Change*, 113, pp.95-106.



Bull, M. (2013) 'Transformative sustainability learning: cultivating a tree-planting ethos in Western Kenya', *Journal of Education for Sustainable Development*, 7, 1, pp.5-21.

Cabinet Office. (2011) [Keeping the Country Running: Natural Hazards and Infrastructure](#). London: Cabinet Office.

Chambers, R. (2008) *Revolutions in Development Inquiry*. London: Earthscan and Institute for Development Studies.

Chen, C. and Lee, W. (2012) '[Damages to school infrastructure and development to disaster prevention education strategy after Typhoon Morakot in Taiwan](#)', *Disaster Prevention and Management*, 21, 5, pp.541-555.

Collins-Figueroa, M. (2012) 'Biodiversity and education for sustainable development in teacher education programmes of four Jamaican educational institutions', *Journal of Education for Sustainable Development*, 6, 2, pp.253-267.

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson, A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, B., Montgomery, H., Napier, D., Pagel, C., Patel, J., Puppim de Oliveira, J.A., Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J. and Patterson, C. (2009) [Managing the Health Effects of Climate Change](#). London: The UCL Lancet Commission.

Courtenay-Hall, P. and Rogers, L. (2002) 'Gaps in mind: problems in environmental knowledge-behaviour modelling research', *Environmental Education Research*, 8, 3, pp.284-297.

CREATE (Consortium for Research on Educational Access, Transitions and Equity). (2008) [Impact of Health on Education Access and Achievement](#). Policy Brief Number 3. Falmer: CREATE and University of Sussex.

Danida and Royal Government of Bhutan (2003) [Education Sector Programme Support Document: Support to 9th Education Five Year Plan](#).

Irene Dankelman (2002) 'Climate change: learning from gender analysis and women's experiences of organising for sustainable development', *Gender & Development*, 10, 2, 21-29.

Das, P.K. (2008) *Responding to the Past. Preparing for the Future: Post Sidr Interventions in Education – Bangladesh*. Dhaka: DFID Bangladesh.

Dasgupta, S., Huq, M., Khan, Z. H., Ahmed, M. M. Z., Mukherjee, N., Khan, M. F., & Pandey, K. (2013) '[Cyclones in a changing climate: the case of Bangladesh](#)', *Climate and Development*, (ahead-of-print), pp.1-15.

Davidson, J. and Lyth, A. (2012) '[Education for climate change adaptation – enhancing the contemporary relevance of planning education for a range of wicked problems](#)', *Journal for Education in the Built Environment*, 7, 2, pp.63-83.

Delors, J. (1996) *Learning: The Treasure Within*. Report to UNESCO of the International Commission on Education for the Twenty-first Century. Paris: UNESCO.

Denton, F. (2002) '[Climate change vulnerability, impacts, and adaptation: Why does gender matter?](#)' *Gender & Development*, 10, 2, pp.10-20.



DFID [Department for International Development] (2014) *Assessing the Strength of Evidence. How To Note*. London: DFID.

DFID (2013) [Project Completion Report: Development Partnerships in Higher Education \(DeIPHE\)](#). London: DFID.

DFID (2011) [Defining Disaster Resilience: A DFID Approach Paper](#). London: DFID.

Dillon, J. (2003) 'On learners and learning in environmental education: missing theories, ignored communities', *Environmental Education Research*, 9, 2, pp.215-226.

Dillon, J., Kelsey, E. and Duque-Aristizábal, A.M. (1999) 'Identity and culture: theorising emergent environmentalism', *Environmental Education Research*, 5, 4, pp.395-406.

Elimu Yetu Coalition (2005) 'The challenge of educating girls in Kenya' in Aikman, S., Unterhalter, E. (eds.), *Beyond Access: Transforming Policy and Practice for Gender Equality in Education*, Oxford: Oxfam, pp.106-127.

Gadgil, M. (2012) 'Parisara: developing a collaborative, free, public domain knowledge resource on Indian environment', *Journal of Education for Sustainable Development*, 6, 2, pp.269-275.

González-Gaudiano, E. (2007) 'Schooling and environment in Latin America in the third millennium', *Environmental Education Research*, 13, 2, pp.155-169.

Gough, S. and Scott, W. (2007) *Higher Education and Sustainable Development: Paradox and Possibility*. London: Routledge.

Grantham-McGregor, S., Cheung, Y.B., Cueto, S., Glewwe, P., Richter, L., Strupp, B. and The International Child Development Steering Group (2007) '[Developmental potential in the first 5 years for children in developing countries](#)', *The Lancet*, 368, pp.60-70.

Guevara, J., Yoshiyuki, N. and Tomoko, S. (2012) [Tales of Hope III: EFA-ESD Linkages and Synergies](#). Tokyo: Asia-Pacific Cultural Centre for UNESCO.

Heimlich, J. and Ardoin, N. (2008) 'Understanding behavior to understand behavior change: a literature review', *Environmental Education Research*, 14, 3, pp.215-237.

Henderson, K. and Tilbury, D. (2004) [Whole-School Approaches to Sustainability: An International Review of Sustainable School Programs](#). Report Prepared by the Australian Research Institute in Education for Sustainability (ARIES) for the Department of the Environment and Heritage, Australian Government.

Hopkins, C. and McKeown, R. (2005) [Guidelines and Recommendations for Reorienting Teacher Education to Address Sustainability](#). Paris: Section for Education for Sustainable Development (ED/PEQ/ESD), Division for the Promotion of Quality Education, UNESCO.

Illeris, K. (2007) *How We Learn: Learning and Non-learning in School and Beyond*. London: Routledge.

IPCC [Intergovernmental Panel on Climate Change] (2013) 'Summary for Policymakers' in Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V. and Midgley, P.M. (eds.), [Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change](#). Cambridge: Cambridge University Press.



IPCC (2012) [*Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*](#). Cambridge: Cambridge University Press.

James, M., McCormick, R., Black, P., Carmichael, P., Drummond, M., Fox, A., Mac-Beath, J., Marshall, B., Pedder, D., Procter, R., Swaffield, S., Swann, J. and Wiliam, D. (2007) *Improving Learning How to Learn: Classrooms, Schools and Networks*. New York: Routledge.

Jiménez-Elizondo, A. (2010) 'CREADS, a teacher training course on ESD in Costa Rica', *Journal of Education for Sustainable Development*, 4, 2, pp.227-234.

Jonassen, D. and Land, S. (eds.) (2012) *Theoretical Foundations of Learning Environments*. London: Routledge.

Jukes, M.C.H., Drake, L.J. and Bundy, D.A.P. (2008) *School Health, Nutrition and Education for All: Levelling The Playing Field*. Wallingford: CABI Publishing.

Kalra, R., Khan, I. and Rehman, O. (2014) [*Final report: Efficiency analysis of classroom infrastructure for primary education in Bangladesh*](#). Evidence on Demand, UK.

Kagawa, F. and Selby, D. (2012) 'Ready for the storm: education for disaster risk reduction and climate change adaptation and mitigation', *Journal of Education for Sustainable Development*, 6, 2, pp.207-217.

Kagawa, F. and D. Selby (eds.) (2010) *Education and Climate Change: Living and Learning in Interesting Times*. London: Routledge.

Krasny, M. Lundholm, C. and Plummer, R. (eds.) (2010) *Resilience in Social-Ecological Systems: the Role of Learning and Education*. Special Issue of *Environmental Education Research*, 16, 5-6.

Kwan, T. and Lidstone, J. (1998) 'Understanding environmental education in the People's Republic of China: a national policy, locally interpreted', *Environmental Education Research*, 4, 1, pp.87-98.

Kyburz-Graber, R., Hart, P., Posch, P. and Robottom, I. (eds.) (2006) *Reflective Practice in Teacher Education. Learning from Case Studies of Environmental Education*. Bern: Peter Lang.

Lawler, J. (2011) [*Children's Vulnerability to Climate Change and Disaster Impacts in East Asia and the Pacific*](#). Bangkok: UNICEF East Asia and Pacific Regional Office.

Lewin, K. (2007) [*Improving Access, Equity and Transitions in Education: Creating a Research Agenda*](#). CREATE Pathways To Access Series, Research Monograph No. 1. Falmer: CREATE and University of Sussex.

Lozt-Sisitka, H. (2004) 'Environmental education research and social change: Southern African perspectives', *Environmental Education Research*, 10, 3, pp.291-295.

Maud, J., Blum, N., Short, N. and Goode, N. (2012) [*Veterinary Students as Global Citizens: Exploring opportunities for embedding the global dimension in undergraduate veterinary education*](#). London: Royal Veterinary College and the Development Education Research Centre, Institute of Education, University of London.



MEP [Ministerio de Educación Pública] (2008) FOCAP-1 Educación Ambiental para el Desarrollo Sostenible para Equipos Regionales. Unpublished paper. Dirección General de Servicio Civil, Centro de Capacitación y Desarrollo, Ministerio de Educación Pública. San José: Government of Costa Rica

Mitchell, T., Tanner, T. and Haynes, K. (2009) [Children as Agents of Change for Disaster Risk Reduction: Lessons from El Salvador and the Philippines](#). Brighton: Institute for Development Studies.

Monroe, M., Oxarart, A., McDonell, L. and Plate, R. (2009) 'Using community forums to enhance public engagement in environmental issues', *Journal of Education for Sustainable Development*, 3, 2, pp.171-182.

Murdan, S., Blum, N., Francis, S., Slater, E., Alem, N., Munday, M., Taylor, J. and Smith, F. (2014) [The Global Pharmacist](#). London: UCL School of Pharmacy and the Development Education Research Centre, Institute of Education.

Muttarak, R. and Lutz, W. (2014) '[Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change?](#)', *Ecology and Society*, 19, 1, article 42.

Nicholles, N., Vardakoulias, O. and Johnson, V. (2012) [Counting on Uncertainty: The economic case for community based adaptation in North-East Kenya](#). Care International and New Economics Foundation.

Nursey-Bray, M., Fergie, D., Arbon, V., Rigney, L., Palmer, R., Tibby, J., Harvey, N. and Hackworth, L. (2013) [Community based adaptation to climate change: The Arabana, South Australia](#). Gold Coast: National Climate Change Adaptation Research Facility.

Nussbaum, M. (2000) *Women and Human Development: The Capabilities Approach*. Cambridge: Cambridge University Press.

Ogbuigwe, A. (2008) 'Delivering education for sustainable development through the MESA partnership', *Journal of Education for Sustainable Development*, 2, 2, pp.157-165.

Ongare, D., Macharia, A., Mwakaje, A., Muchane, M., Warui, C., Mugoya, C., Masiga, C., Nikundiwe, A., Mui, A. and Wakibara, J. (2013) 'Environmental communication: a review of information sources and communication channels for enhanced community-based natural resource management in the Greater Mara Region of Kenya', *Journal of Education for Sustainable Development*, 7, 1, pp.65-74.

Palmer, J. (1998) *Environmental Education in the 21st Century: Theory, Practice, Progress and Promise*. London: Routledge.

Pigozzi, M.J. (2007) 'Quality in education defines ESD', *Journal of Education for Sustainable Development*, 1, 1, pp.27-35.

Reid, H., Cannon, T., Berger, R., Alam, M. and Milligan, A. (eds.) (2009) [Community-based Adaptation to Climate Change](#). Special Issue of *Participatory Learning and Action*, Vol 60. International Institute for Environment and Development.

Rickinson, M. (2001) 'Learners and learning in environmental education: a review of recent research evidence', *Environmental Education Research*, 7, 3, pp.207-317.



Salem, B. (2012) 'ESD as a means to strengthen the sustainable management of marginal drylands in Egypt', *Journal of Education for Sustainable Development*, 6, 2, pp.279-286.

Save the Children. (2008) [Legacy of Disasters: The Impact of Climate Change on Children](#). London: Save the Children.

Scott, W. and Vare, P. (2008) [Education for Sustainable Development: Two Sides and an Edge](#). DEA Thinkpiece. London: Development Education Association.

Sen, A. (1999) *Development as Freedom*. Oxford: Oxford University Press.

Shohel, M. and Howes, A. (2011) 'Models of education for sustainable development and nonformal primary education in Bangladesh', *Journal of Education for Sustainable Development*, 5, 1, pp.129-139.

Sterling, S. (2010) 'Learning for resilience, or the resilient learner? Towards a necessary reconciliation in a paradigm of sustainable education', *Environmental Education Research*, 16, 5, pp.511-528.

Sterling, S. (2001) *Sustainable Education: Re-visioning Learning and Change*. Schumacher Briefing No. 6. Dartington: Green Books.

Tschakert, P. and Dietrich, K. A. (2010) '[Anticipatory learning for climate change adaptation and resilience](#)', *Ecology and Society*, 15, 2, article 11 (online).

Toya, H. and Skidmore, M. (2007) '[Economic development and the impacts of natural disasters](#)', *Economics Letters*, 94, 1, pp.20-25.

United Nations (2006) [Tsunami: India Two Years After: A Joint Report of the United Nations, World Bank, and Asian Development Bank](#). United Nations.

UNCED. (1992) *Agenda 21, The United Nations Programme of Action from Rio*. New York: United Nations.

UNDP (2009) [Resource Guide on Gender and Climate Change](#).

UNDP (2007) [Human Development Report 2007/2008, Fighting Climate Change: Human Solidarity in a Divided World](#). New York: UNDP.

UNESCO (2014) [Teaching and Learning: Achieving Quality Education for All](#). Education For All Global Monitoring Report 2013/14. Paris: UNESCO.

UNESCO (2010) [Reaching the Marginalised. Education For All Global Monitoring Report 2010](#). Paris: UNESCO.

UNESCO (2009) [Overcoming Inequality: Why Governance Matters. Education For All Global Monitoring Report 2009](#). Paris: UNESCO.

UNESCO (2006) [Framework for the UN DESD International Implementation Scheme](#). Paris: UNESCO.

UNESCO and UNICEF (2013) [Making Education a Priority in the Post-2015 Development Agenda: Report of the Global Thematic Consultation on Education in the Post-2015 Development Agenda](#).



UNICEF (2004) [Schooling Spluttering to a Start in Flood-Affected Districts of Bihar](#).
Published online.

UNISDR [United Nations International Strategy for Disaster Risk Reduction] (2011) [Hyogo Framework for Action 2005–2015, Building the Resilience of Nations and Communities to Disasters: Mid-Term Review 2010–2011](#). Geneva: UNISDR.

UNISDR (2009) [Terminology on Disaster Risk Reduction](#). Geneva: UNISDR.

Urbano, M., Deasey, M., Kusumawardani, N. and Pardosi, J. (2011) [The Impacts of Climate Change on Nutrition and Migration Affecting Children in Indonesia](#). Report commissioned by UNICEF Bangkok.

Vardakoulias, O. and Nicholles, N. (2014) [Managing uncertainty: An economic evaluation of community-based adaptation in Dakoro, Niger](#). Care International and New Economics Foundation.

Vize, S. (2012) 'Using education to bring climate change adaptation to Pacific communities', *Journal of Education for Sustainable Development*, 6, 2, pp.219-235.

Vulliamy, G. (1988) 'Environmental education in third world schools: rhetoric or realism' in Briceno, S. and Pitt, D.C. (eds.), *New Ideas in Environmental Education*. London: Croom Helm.

Wals, A. (2011) 'Learning our way to sustainability', *Journal of Education for Sustainable Development*, 5, 2, pp.177-186.

Wals, A. (ed.) (2007) *Social Learning Towards a Sustainable World: Principles, Perspectives and Praxis*. Wageningen: Wageningen Academic Publishers.

Weichselgartner, J. and Kelman, I. (2014) '[Geographies of resilience: challenges and opportunities of a descriptive concept](#)', *Progress in Human Geography*, Published online 7 February 2014.

Wheeler, D., Blankespoor, B., Dasgupta, S. and Laplante, B. (2010) [The Economics of Adaptation to Extreme Weather Events in Developing Countries](#). Working Paper 199. Washington, DC: Centre for Global Development.

WHO (2008) [Climate Change and Human Health: Risks and Responses](#). Geneva: World Health Organization.

Willott, C., Blum, N., Burch, W., Page, B. and Rowson, M. (2012) [The Global Doctor](#). London: UCL Institute for Global Health and the Development Education Research Centre, Institute of Education, University of London.



Where to go for more information

DFID publications and resources

DFID (2011) [Defining Disaster Resilience: A DFID Approach Paper](#). London: DFID.

DFID (n.d.) Promoting safety, resilience and social cohesion through education: A capacity development process in support of ministries of education [draft concept note]. London: DFID.

Jowitt, P. and Johnson, A. (2014) [Topic Guide: Carbon Management of Infrastructure Services](#). Evidence on Demand, UK.

Ranger, N. (2013) [Topic Guide: Adaptation: Decision making under uncertainty](#). Evidence on Demand, UK.

Brooks, N.; Aure, E.; Whiteside, M (2014) [Final report: Assessing the impact of ICF programmes on household and community resilience to climate variability and climate change](#). Evidence on Demand, UK

Academic research on climate change, environment, sustainability and education

Blewitt, J. and Tilbury, D. (2014) *Searching for Resilience in Sustainable Development: Learning Journeys in Conservation*. London: Routledge.

Courtenay-Hall, P. and Rogers, L. (2002) 'Gaps in mind: problems in environmental knowledge-behaviour modelling research', *Environmental Education Research*, 8, 3, pp.284-297.

Davidson, J. and Lyth, A. (2012) '[Education for climate change adaptation – enhancing the contemporary relevance of planning education for a range of wicked problems](#)', *Journal for Education in the Built Environment*, 7, 2, pp.63-83.

Davis, J. and Elliot, S. (2014) *Research in Early Childhood Education for Sustainability: International Perspectives and Provocations*. London: Routledge.

Guevara, J., Yoshiyuki, N. and Tomoko, S. (2012) [Tales of Hope III: EFA-ESD Linkages and Synergies](#). Tokyo: Asia-Pacific Cultural Centre for UNESCO.

Heimlich, J. and Ardoin, N. (2008) 'Understanding behavior to understand behavior change: a literature review', *Environmental Education Research*, 14, 3, pp.215-237.

Henderson, K and Tilbury, D. (2004) [Whole-School Approaches to Sustainability: An International Review of Sustainable School Programs](#). Report Prepared by the Australian Research Institute in Education for Sustainability (ARIES) for The Department of the Environment and Heritage, Australian Government.

Hopkins, C. and McKeown, R. (2005) [Guidelines and Recommendations for Reorienting Teacher Education to Address Sustainability](#). Paris: Section for Education for Sustainable Development (ED/PEQ/ESD), Division for the Promotion of Quality Education, UNESCO.



Kagawa, F. and D. Selby (eds.) (2010) *Education and Climate Change: Living and Learning in Interesting Times*. London: Routledge.

Kola-Olusanya, Anthony. (2005) 'Free-choice environmental education: understanding where children learn outside of school', *Environmental Education Research*, 11, 3, pp.297-307.

Muttarak, R. and Lutz, W. (2014) '[Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change?](#)', *Ecology and Society*, 19, 1, article 42.

Pigozzi, M.J. (2007) 'Quality in education defines ESD', *Journal of Education for Sustainable Development*, 1, 1, pp.27-35.

Reid, H., Cannon, T., Berger, R., Alam, M. and Milligan, A. (eds.) (2009) [Community-based Adaptation to Climate Change](#). Special Issue of *Participatory Learning and Action*, Vol 60. International Institute for Environment and Development.

Scott, W. and Vare, P. (2008) [Education for Sustainable Development: Two Sides and an Edge](#). DEA Thinkpiece. London: Development Education Association.

Selby, D. and Kagawa, F. (2012) [Disaster Risk Reduction in School Curricula: Case Studies from Thirty Countries](#). Paris: UNESCO and UNICEF.

Shephard, A et al (2013): [The geography of poverty, disasters and climate extremes in 2030](#). ODI, Met Office and Risk Management Solutions. London:ODI

Sterling, S., Macey, L. and Luna, H. (2014) *The Sustainable University*. London: Earthscan Routledge

Wals, A. (ed.) (2007) *Social Learning Towards a Sustainable World: Principles, Perspectives and Praxis*. Wageningen: Wageningen Academic Publishers.

Helpful web resources

Teaching resources on climate change and ESD

British Council [Climate 4 Classrooms](#) – A well-regarded series of teaching resources to support schools around the world to teach, think and talk about the global and intercultural dimensions of climate change. It contains learning activity ideas, sample lesson plans, tips and further resources to use with pupils aged 7 to 16 years.

UN [Decade of Education for Sustainable Development](#) – Online resources about the current Decade, including research and case studies from around the world. It also offers helpful resources on [Teaching and Learning for a Sustainable Future](#).

Climate change research resources

[Children in a Changing Climate](#) Programme – A coalition of leading child-focused research, development and humanitarian organisations, led by the Institute of Development Studies in partnership with Plan, Save the Children, UNICEF and World Vision. The website features a range of learning and research resources based on the coalition's research and advocacy work around the world.

ELDIS [Key Issues on Climate Change](#) resources – A large collection of research, guides and case studies on a range of climate change themes, including indigenous knowledge, gender, vulnerability reduction, building resilience, climate-smart agriculture and water management.



[Gender and Water Alliance](#) – A global network dedicated to mainstreaming gender in water resources management, with over 2,100 members in more than 125 countries worldwide. The website offers a range of resources, including research articles, case studies, policy studies, fact-sheets and publications on issues related to gender and water.

Community-based adaptation resources

Care International's [Community-Based Adaptation Toolkit](#), FAO's [E-learning Tool – Community based adaptation to climate change](#), and ELDIS pages on [Community Based Adaptation to Climate Change](#)

DFID's [Community-Based Adaptation in Africa](#) project

UNDP's [Community-Based Adaptation Project](#)

[International Institute for Environment and Development](#) has also initiated long-term research and development partnerships with researchers, practitioners and communities in Bangladesh.

Key global climate change and education networks

[Asia-Pacific Cultural Centre for UNESCO ESD programme](#) – An active and well-regarded ESD organisation established in 1971 and led by the Japanese National Commission for UNESCO in order to contribute to mutual understanding and cultural cooperation in Asia and the Pacific. The programme acts as an important forum for educators and facilitators working on ESD and climate change, and provides support for research and innovation in practice.

[UK Commonwealth Scholarship Commission Alumni Network](#) – A global network of the over 17,000 Commonwealth Scholars and Fellows that have been funded by the UK government since 1959. The searchable [Online Directory of Commonwealth Scholars and Fellows](#) may be an especially helpful tool for finding experts and colleagues in specific regions or countries.

United Nations [Climate Change Information Network](#) – A clearinghouse for information sources on public information, education and training in the field of climate change. It is designed to help governments, organisations and individuals gain easy access to ideas, strategies, contacts, experts and materials that can be used to empower people to take effective action on climate change. The Network includes a [Youth Portal](#) which is aimed specifically at engaging children and young people in climate change issues.

United Nations University's [Regional Centres of Excellence](#) in ESD – A key network of institutions that are designed in order to strengthen the collaboration between educational, research institutions and other regional actors. Core activities include research, curriculum development, educational capacity development, support for curriculum coordination at different levels, and facilitating links between science, research, educational institutions, policy makers, and industrial organisations.

[UNESCO Teacher Education Network](#) – An active network of teacher education institutions from 60 nations around the world. Member institutions work to incorporate sustainability into their programmes, practices and policies. Each institution addresses environmental, social, and economic contexts to create locally relevant and culturally appropriate teacher education programmes for both pre-service and in-service teachers. The website also includes a useful range of [technical papers, case studies of good practice, and training tools](#) related to teacher education, climate change and sustainability.



UNEP [Global Universities Partnership on Environment and Sustainability](#) – A UN-supported network for collaborative projects among universities, governments, civil society, communities and the private sector.