Climate Change and Global Warming in Science and Geography Curricula of Tamil Nadu and Puducherry Schools

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ABSTRACT

Climate change and the associated global warming are considered the world's worst environmental threat, and the greatest challenge facing human society in the twenty-first century. Education and communication is one of the powerful strategies to address various local adaptation and mitigation strategies to tide over such critical problems. This study was aimed at assessing the extent to and ways in which global climate change and global warming has been addressed in the science and geography curricula in Tamil Nadu and Puducherry schools text books. Content analysis was used as a principal technique to gather data based on the curriculum guides and textbooks. Results show that the curriculum guides for Tamil Nadu and Puducherry schools science and geography text books provide a major opportunity to systematically integrate issues related to global climate change and global warming. The school textbooks for middle school level adequately cover the science behind climate change and global warming including its causes and consequences. However, issues related to the politics of global climate change and personal commitments to change the attitudes, behaviour are largely missing in the middle school level text books. The impact of human actions is, for instance, not clearly articulated while discussing factors that contribute to global climate change. Similarly, adaptation and mitigation measures against climate change have been least emphasized in textbooks.

Keywords: Climate Change, Curriculum, Education, Science, Geography, Textbooks

INTRODUCTION

Most people in our society are still unconcerned or ignorant on the issue of climate change, though it is currently at the centre of our day to day life. The students are the guardian of our earth and future generations. There is an urgent need to create awareness among students on climate change and its associated problems. In order to address the climate change education the United Nations Framework Convention on Climate Change (UNFCCC) calls on countries to promote and facilitate education and public awareness of climate change (UNESCO, 2009). Incorporating climate change and environmental education, into a student centered curriculum ensures the realization of student's environmental rights. Students should learn about issues like sustainable development and its impact on environmental interaction and climate change. In the present study an attempt is made to assess the extent in which the climate change and global warming contents incorporated at the middle school level text books of Tamil Nadu.

LITERATURE REVIEW

A number of studies and synthesis reports have concluded that climate change is inevitably underway and that human modification of the landscape and the atmospheric composition of greenhouse gases are likely to be the dominant forcing (AGU, 2007; IPCC, 2007; CCSP, 2008). These changes can alter regional albedo, hydrology, and biogeochemical cycles (Pielke *et al*., 2011) and can impact regional temperatures, precipitation patterns and more broadly the Earth's climate. Changes in the Earth's climate can have a multitude of socioeconomic impacts that can impact individuals, societies and businesses at regional to global scales (CCSP, 2008). Thus, it is important that students learn about global warming and climate change in order to understand the causes and implications of and to prepare for a changing climate: Education is an essential element of the global response to climate change. It helps young people understand and address the impact of global warming, encourages changes in their attitudes and behaviour and helps them adapt to climate change related trends. (UNESCO, downloaded 31 January 2013). Climate change is by far the most important environmental issue facing society and as such is an important environmental education topic (Jickling 2001).

Climate change projections made for India indicate an overall increase in temperature by 1 to 40C and precipitation by 9–16% towards 2050s (Krishna Kumar *et al*., 2011). However, different regions are expected to experience differential change in the amount of rainfall that is likely to be received in the coming decades. Another significant aspect of climate change is the increase in the frequency of occurrence of extreme events such as droughts, floods and cyclones. All of these expected changes will have adverse impacts on climate sensitive sectors such as agriculture, forest and coastal ecosystems and also on availability of water for different uses and on human health.

CLIMATE CHANGE EDUCATION (CCE) GLOBAL PERSPECTIVES

Climate change, and the students and community actions needed to address its challenges, is not a new topic for education. Both can be found in environmental teaching materials from recent decades. Recently, climate literacy has received widespread recognition among educators, researchers and education planners , more from the developed world, recognising the importance of educating children to take a positive stance on social and environmental issues (Shafer, 2008; Stephens & Graham, 2008; Shafer, James, & Giuliano, 2009; Dupigny-Giroux, 2010) and growing number of schools are seeking to embed CCE for sustainable development principles in curriculum planning (Henderson *et al*., 1993; Johnson *et al*., 2008; Shepardson *et al*., 2009; Makrakis *et al*., 2013). Indeed, Climate Change Education (CCE) has not emerged as an independent field, but rather as an integral part of Environmental Education (EE) and ESD. In fact, CCE has only gradually developed its own identity during the last decade, and is therefore still in its infancy (Læssøe *et al*., 2009; Anderson, 2012; Blum *et al*., 2013). Recently, the

integration of climate change across the school curriculum is attempted through ICT-enabled integration of climate change education (CCE) (Makrakis *et al.,* 2013).

In some countries, this recent development is driven by government initiatives concerning climate change. In the Chinese government for example, climate change action plans include specific education initiatives (Rajib Shaw and Phong Tran, 2012). Thus, knowledge about CC will be included in basic, higher and adult education with a focus on awareness and participation in relevant activities (Yi and Wu, 2009). Similarly, in the Canadian province of Newfoundland and Labrador, there has been a Climate Change Action Plan since 2005, which emphasizes CCE. In this province, the origin of the action plan may be attributed to the clearly visible local effects of climate change (Nazir *et al*., 2009). The Danish government's 2009 ESD strategy also launched a number of specific initiatives concerning CCE. New CCE initiatives under the rubric of EE and ESD can likewise be found in other countries (Breiting *et al*., 2009). In Australia, where ESD is well established, the new and ambitious National Solar School Initiative has been launched under the auspices of ESD but with specific reference to climate change (Chambers, 2009). In addition to these government-led initiatives, there are also examples of other concrete initiatives organized by NGOs and other institutions. Furthermore, in Brazil, various other stakeholders like the corporate sector, academic community and media are also involved in debating the role and place of CCE. This is true of many other countries as well (Jacobi *et al*. 2009; Læssøe *et al*., 2009).

CLIMATE CHANGE EDUCATION (CCE) INDIAN PERSPECTIVES

While there is emerging awareness of the current and potential impacts of climate change education, it is also clear that education formal and non formal, from primary through to tertiary and adult education has an important role to play in addressing this change. In India, The Centre for Environment and Climate Change (CECC) was established in March 2009, to develop and implement a research agenda on issues of environment, development and climate change with specific reference to India and South East Asia. In dealing with challenge of climate change, the eight national missions have been evolved. They are national solar mission, national mission on enhanced energy efficiency, national mission on sustainable habitat, national water mission, national mission for sustaining the Himalayan ecosystem, national mission for a green India, national mission for sustainable agriculture and national mission for strategic knowledge for climate change on climate change were adapted focusing on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation.

Article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) (also known as the New Delhi work program) directs countries to consider education, training and public awareness as integral to responses to climate change. Increasingly, country plans developed utilising the UNFCCC

framework do incorporate education-specific elements. However, the degree of success of such plans will be determined by the extent to which countries recognise and are able to adequately resource responses to the challenges posed by climate change, namely: extreme weather events, changes in seasonality, population movements, and demand side and health impacts on enrolment, attendance and educational performance. These challenges will need to be addressed both in terms of educational infrastructure as well as teaching and learning. (UNFCCC, 2014).

India is faced with the challenges of sustaining its rapid economic growth while dealing with the global threat of climate change. This threat emanates from accumulated greenhouse gas emissions in the atmosphere, anthropogenically generated through long-term and intensive industrial growth and high consumption lifestyles in developed countries. While engaged with the international community to collectively and cooperatively deal with this threat, India needs a national strategy to firstly, adapt to climate change and secondly, to further enhance the ecological sustainability of India's development path (NAPCC, 2012).

CLIMATE CHANGE EDUCATION (CCE) TAMIL NADU PERSPECTIVES

The Tamil Nadu government recognises the importance of knowledge for managing its natural resources. The government has already started to document the climate trends, status of its environment and natural resources, and the new innovations that are being implemented as remedial steps to stop the degradation of the resources due to human influences. The seventy percent of the population in Tamil Nadu reside inland and in the coastal areas that are vulnerable to the observed changes, which is likely to exacerbate with projected changes in the future. The state and its resources are susceptible to the projected increase in temperature, intensities of rainfall, droughts, cyclones, storm surges, and the global sea level rise.

Education is an essential element of the global response to climate change. It helps young people understand and address the impact of global warming, encourages changes in their attitudes and behaviour and helps them adapt to climate change-related trends (UNESCO, 2012). Through its Climate Change Education for Sustainable Development programme, UNESCO aims to make climate change education a more central and visible part of the international response to climate change. The programme aims to help people understand the impact of global warming today and increase "climate literacy" among young people. It does this by strengthening the capacity of its Member States to provide quality climate change education; encouraging innovative teaching approaches to integrate climate change education in school and by raising awareness about climate change as well as enhancing non-formal education programmes through media, networking and partnerships. UNESCO responds to climate change through education within the framework of the UN Decade of Education for Sustainable Development (DESD, 2010).

Effective education helps build students adaptive capacity by imparting the knowledge and skills that will enable them to make informed decisions about how to adapt their lives to the ecological, social and economic realities of a changing environment. Such education is most effective when it begins in the early years, before children start primary school, continues through the secondary level of education and leads to lifelong learning in adulthood.

Students need to understand the causes and consequences of climate change, so that they can foster the acquisition of skills and dispositions that individuals and communities need to achieve low-carbon and climate-resilient development through their families. It also enhances the education system's preparedness for and responses to climate change, both in terms of mitigation and adaptation. Children can be powerful agents of change, and they can be resilient when faced with challenges. Research has shown that providing them with empowering and relevant education on disasters and climate change in a child-friendly school environment can reduce their own and their community's vulnerability to risk while contributing to sustainable development (UNICEF, 2012). Children's knowledge and capacities can be invaluable to the development of realistic and Practicable adaptation plans. The aim of present study was to assess the extent of climate change and global warming contents incorporations in the school text books in Tamil Nadu state curriculum and how these contents changes the students knowledge, attitudes, behaviour and skills

OBJECTIVES

The study was carried out to know how far the scientific basis of climate change, impacts of climate change, adaptation and mitigation and possible measures of climate change have been incorporated into school text book curriculum of science, social science and geography curricula for middle schools of Tamil Nadu and Puducherry. The content analysis has been used as a principal technique (Berelson, 1952, cited in Asgedom, 1998).

The revised curriculum guides for science and social science class 6–10 have been analyzed. The students' textbooks have been assessed the contents of climate change under three broad categories such as scientific basis, investigating and evaluating impacts and actions against the problem.

METHODS

Three such categories have been determined on the basis of review of literature: the scientific basis of climate change, impacts of climate change, measures against climate change and adaptation and mitigation options for climate change. Twelve such terms and phrases have been identified for each of the three analytical categories.

Both quantitative and qualitative techniques have been used to analyze information and present results. The climate change and global warming in Tamil Nadu and Puducherry educational system has been assessed qualitatively. The extent to which issues related to global climate change have

been integrated into the science and geography curriculum, guides for secondary schools has been assessed quantitatively by computing the proportion of objectives devoted to climate change in each grade finally, the way climate change has been treated in each of the students' textbooks is assessed qualitatively (Berelson, 1952, cited in Asgedom, 1998).

RESULTS

The present study identified 13 terms/phrases (Table 1) of the three analytical categories related to climate change: scientific basis, impacts and actions against the problem. From Category I, the concepts of ecosystem, biodiversity, fossil fuels and energy and weather and climate have been presented in all the class except seventh class (Class 6, 8, 9 and 10). The greenhouse effects (in class 8) are the other concepts covered from this category. On the other hand, five of the 13 terms and phrases identified for this category (per-capita emissions, uncertainties in climate change, carbon sequestration, ozone hole and El Nino/La Nina) have not been adequately addressed.

From Category II, only ecosystem change has been adequately addressed in all the five classes. Global warming, water stress and increased vulnerability to extreme weather events have been addressed in three of the five classes, whereas increased food insecurity has been addressed in two classes. The spread of deserts and slower progress toward sustainable development have been addressed in only one grade. On the other hand, three of the 13 terms/phrases identified for this category (glacial melting, sea level rise and spread of diseases) have not been adequately addressed.

From Category III, mitigation measures, adaptation measures and afforestation/ reforestation have been discussed in some extent in seventh class. The Indian environmental policy, national action plan for climate change and international conventions has not been discussed almost in all classes. Although India has signed all the landmark conventions related to climate change, no reference has been made to any of the important documents in the school text books that have been reviewed long after the issuance of such international policies.

Table 1: Coverage of Climate Change and Global Warming Contents in Tamil Nadu Middle School Level Science and Geography Text Books

Categories	Class 6	Class 7	Class 8	Class 9	Class 10
Scientific Basis					
Ecosystem (ES)		ES			ES
Biodiversity (BD)	BD	BD	BD	BD	BD
Weather and climate (WC)		WC	WC	WC	
Fossil Fuels and energy (FFE)	FFE	FFE	FFE	FFE	FFE
Greenhouse gases (GG)					
Greenhouse effect (GE)			GE		
Per-capita emission (PE)					
Uncertainties in climate change (UCC)					
Carbon sequestration (CS)					
Ozone hole/ozone depletion (OD)			OD	OD	OD

Table 1 (Contd.)…

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Categories	Class 6	Class 7	Class 8	Class 9	Class 10
Landslides (LS)					
Monsoons (MS)	MS	MS	MS		
El Nino/ La Nina (EN)		EN			
Investigating and Evaluating Impacts					
Ecosystem change (EC)					
Global warming (GW)		GW	GW		GW
Glacial melting (GM)		GM			
Sea level rise (SLR)					
Water stress (WS)		WS			WS
Spread of deserts (SD)					
Natural disasters (ND)		ND	ND		
Ocean acidification (OA)					
Increased food insecurity (FI)					
Spread of diseases (SD)					
Increased vulnerability to extreme weather events (VWE)		VWE			
Slower progress toward sustainable development (SSD)					
Actions Against the Problem					
National action plan for climate change (NAPCC)					
UN Framework Convention on Climate Change (UNFCC)					
Intergovernmental Panel on Climate change (IPCC)					
The Kyoto protocol (KP)					
Mitigation measures (MM)					
Adaptation measures (AM)		AM			
Reforestation/afforestation (RA)			RA		
Renewable/green energy (RGE)					RGE
Recycling/waste management (WM)	WM		WM		WM
Agriculture/water managements (AM)			AM	AM	AM
Organic farming (OF)					
Environmental/CC education (CCE)					
India's climate change action plan (ICCAP)					
Total	4	12	11	5	9

CONCLUSION

The assessment of the content in science and geography curriculum Tamil Nadu textbooks indicate The existing curriculum guides for science and geography at middle school levels offer ample opportunities for a systematic integration of issues related to global climate change without adding much curricular time and space, Some aspects of global climate change have already been sufficiently integrated into the geography curriculum guides for middle school levels, these are related mainly to the science of weather and climate and basic notions of environment and ecosystem. There are still gaps in the textbooks that could hinder a holistic understanding of the problems of global climate change. The textbooks provide the least opportunity for students to contribute to actions aimed at abating the impacts of climate change.

The findings of the study thus have mixed implications. The school science and geography text books are not well equipped to create positive attitudes,

behaviour to do combating for climate change. According to Stern (2007), fostering a shared understanding of the nature of climate change, and its consequences is critical in shaping behaviour, as well as in underpinning national and international action. Educating those currently at school about climate change will help shape and sustain future policy making, and a broad public and international debate will support today's policy makers in taking strong action now Regardless of how climate change is manifested, mitigation and adaptation are two complementary strategies that reduce risk and strengthen affected communities. 'Mitigation' covers all actions to decrease greenhouse gas emissions. 'Adaptation' changes natural and human systems to minimize the risks faced by vulnerable populations. Based on context, both mitigation and adaptation should be incorporated within child-friendly schools. children to develop holistic views of climate change and take appropriate action, they must understand the complex interrelationships between mitigation and adaptation and how school communities can contribute to both.

Incorporating climate change education into the curriculum, with adaptations for the local context, lessons on key climate change topics such as global warming, the greenhouse effect and weather-related disasters are not enough. At-risk communities must develop local adaptation policies and practices, addressing disaster risk reduction, emergency preparedness and locally relevant sustainable development options. A nationally significant, child-focused, participatory approach works best.

Development of green school curricula can include key concepts of quality climate change education. The green schools design approach itself describes environmentally sustainable schools. Well-designed green schools provide ample natural light, good indoor air quality and ventilation. They are water and energy efficient and use nontoxic, locally available construction materials, renewable energy, butterfly garden and organic garden recently Jawahar Navodya Vidyalaya (JNV) is selected as one among the top ten green schools in South India by the centre for science and environment New Delhi incidentally, the children from this school bagged an award best Trend Setter in the year 2013. The Green School in Puducherry is developed almost exclusively with locally renewable resource. The place based education, the first hand experience is a key factor in learning about natural environment, the research conducted by Alexandar and Poyyamoli (2012) in JNV school Puducherry has found that the students participated in butterfly education program has increased their knowledge, interest and changes in conservation behaviour it has led to set up a butterfly garden within the school campus. The school's mission is to develop responsible and green habits in its learners in an environment that models the principle of sustainability being taught. However, the pressing nature of climate change requires educational responses that go beyond the simple provision of new curriculum content. Reflection is also needed regarding the relative emphasis placed on educational access and schooling, as opposed to what is actually learned in classrooms and the degree to which learning equips and empowers people to deal with rapid change. This will in turn require the development of sound pedagogical approaches, curricula, and assessment strategies, as well as of conducting learning environments both inside and outside of educational institutions.

Furthermore, high quality teaching and learning is most likely to take place when it is supported by appropriate approaches to curricula, pedagogy and systems of assessment (Alexander, 2008). The multiple teaching and learning strategies will enhance students understanding, attitudes and behaviours towards to conservation of natural resources (Ramadoss and Poyyamoli, 2011). Standardized testing, for example, which requires students to show mastery of particular curriculum content is likely to lead schools and teachers to rely on memorization and rote learning, rather than to use activities which develop critical thinking or problem-solving skills to enhance the adaptive capacity to respond to climate change. In other words, encouraging high quality teaching requires curricula, teaching approaches and systems of assessment, which place value on high quality action learning.

A well-planned programme of CCE across and within the curriculum will provide students with opportunities to address the causes (mitigation) and the consequences (adaptation) of climate change by adopting a transformative learning approach. The various activities related to climate change education with more extensive local perspectives will improve the students understanding the real world complexities of climate issues and change their attitude and behaviour to adapt and mitigation strategies in changing climatic conditions (Alexandar and Poyyamoli, 2012) As the causes of climate change are basically anthropogenic, causes and consequences need to be identified and changed so as to influence the skills, attitude and behaviour of the student community. This inculcates the values underpinning the action required behind the climate smart sustainable development among the student community. The available evidence shows that educational interventions are most successful when they focus on local, tangible, and actionable aspects of sustainable development, climate change and environmental education, especially those that can be addressed by individual behaviour. To this end it is high time that the high school curricula are redesigned to incorporate these vital issues.

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