ROLE OF EDUCATION IN COMBATING CLIMATE CHANGE

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ROLE OF EDUCATION IN COMBATING CLIMATE CHANGE

By

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A Global Think Tank in Higher Education

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ROLE OF EDUCATION IN COMBATING CLIMATE CHANGE

EDUCATION FOR SUSTAINABILITY AND PROMOTING CLIMATE CHANGE AWARENESS

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Introduction

This chapter addresses one of the key challenges for work on education related to education for sustainability and promoting climate change awareness, meaning environmental concerns, and especially the pressing issue of climate change: the overall conceptualization of central ideas such as Education for Sustainability (ES) and Climate Change Education (CCE). It is a challenge both in terms of the research which seeks to develop and engage with the concepts themselves and in terms of the influences of those complex concepts on policy and practice in particular locations: What do these concepts mean in diverse contexts and amongst diverse actors? What are the connections and disconnections between existing perspectives? What are the impacts of these different understandings on educational policies and practice at various levels in different locations (e.g. local, national, regional, international)?

After all education and lifelong learning are increasingly being mobilized to address the global environmental crisis and accompanying, sustainability challenges (Wals & Benavot, 2017). This chapter discusses the many roles of education about and for ES and CCE drawing on evidence and arguments put forward in the 2016 Global Education Monitoring Report, Education for People and Planet. It highlights specific viewpoints, values and ways of thinking that best characterize effective learning for sustainability. It also emphasizes the importance of a 'whole school' or 'whole institutional' approach to education for sustainability.

Others outside the UN agree with the youth at COP20 that inaction on climate change is as dangerous as improper action. A roundtable which was overseen by the U.S. Board on Science Education, the Board on Environmental Change and Society, and the Division on Earth and Life Studies, met during a recent workshop to focus on the teaching and learning of climate change and climate science in formal education settings (National Resources Council 2012). Participants linked formal education to the necessary links between scientific and technical analysis with public deliberation and decision making as stated in *America's Climate Choices* (National Resources Council 2011) as critical to effective responses to climate change in which citizens understand the risks of both action and inaction and to engage in effective deliberation about all available choices.

Environmental education is a recently evolved academic field and climate change education is newer still and fraught with the expected controversy surrounding a new far-reaching discipline (Schreiner, 2005). In 1968 the United Nations Educational, Scientific and Cultural Organization (UNESCO) called for curriculum development in environmental education at all grade levels and the stimulation of global awareness to environmental problems (Palmer 2001). As the Millennium Development Goals (MDGs) morph into the new Sustainable Development Goals (SDGs) in 2015, climate change as a focal point for youth action is increasingly targeted through initiatives such as UNEP and UNESCO's *youthXchange* guidebooks that enable educators and young people to personalize learning and climate change resilience actions (Anderson 2012). Those actions range widely from public health to ocean acidification, multilateral processes, collaboration and conflict, international capacity development, climate equity, green building, food security, insurance, finance

and business, sustainable development and disaster risk reduction.

While international and national level declarations are important attestations of high-level support, outcomes from meaningful environmental education in creating preferable outcomes to climate and other environmental change play out at local levels illustrating how everyone's "global" is someone else's "local." While there is no endpoint to climate change, research points to behaviours with the largest potential benefits having a requirement of political engagement that is developed through experiences associated with young people's interests in public issues (Chawla 2007). Often beginning with personal actions like those in the home or in public arena like schools and communities, these experiences require a personal sense of competence and a sense of collective competence, or confidence in one's ability to achieve goals by working with a group.

Through experience, the editors of this volume know that the most effective environmental work is, as Sea Trust Institute says, "Local to Global and Back Again (SM)." Engaging university students and pre-university youth with the science, engineering, social and policy processes that make their community more resilient to environmental change creates an opportunity for global dialogue and focuses this text on developing a deeper understanding of social learning in the transition from awareness to action.

The word *resilience* has its origins in the Latin word *resilíre*, meaning to spring back quickly or recover from difficulties (OECD, 2009). Contemporary theorists and researchers consider resilience within the constraints of their disciplinary focus; while engineers focus on efficiency and assume constancy and predictability. On the other hand, ecologists focus on persistence, despite changes and unpredictability, theories of adaptive capacity and resilience of complex systems such as the coupled systems of climate change and society concentrate on the management of dynamic, unstable or non-equilibrium systems that coevolve self-organize and negotiate in cyclical, non-linear patterns.

Conceptualizations of EE, ESD and CCE

Once can safely infer that that there exists a diversity of understandings of ESD and its related terms (including EE and CCE) which have been have developed – and continue to develop – worldwide. The situation is further complicated, by the fact that multiple meanings coexist in many countries, used simultaneously by various individuals and organisations at a range of governmental and geographic scales.

This in itself is not surprising, since all of these terms (ESD, EE and CCE) are by their nature conceptually complex, as are their component words – education, environment, sustainable, development and climate change. The meanings of the term 'development' has been a key subject of debate for at least the last half century, with perspectives ranging from an emphasis on promoting economic growth in so-called 'underdeveloped' nations to a growing interest in human and social development (e.g. as represented by the UN's Human Development Index and authors such as Amartya Sen).

The term 'sustainable' has also been appended to the term in order to create a concept, which is commonly defined in international policy discourse as 'development which meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (WCED 1987). And while the theoretical goal of sustainable development – namely, balancing economic, social and environmental concerns – has become largely accepted within mainstream development discourse, the term also brings with it further complexities and challenges, including on-going debates about how to either define or achieve it in practice (Stevenson 2008).

Perhaps what it is more important for us to consider at this point are the factors that lead

to particular conceptualizations of these key terms, and how these local and national contingencies impact policy and practice for EE, ESD and CCE in exemplar countries. Such an approach may generate ideas and stimulate further discussion relevant to the understanding and future development of the focal concepts. Four of these factors are discussed here: perceptions of the relationships between EE and ESD; treatment of CCE; national context; and international pressures. The discussion is supported by illustrative examples from India as well as international, and so are likely to resonate with experiences. Further, it should be noted that the precise meanings of the terms EE, ESD and CCE, as well as which terms are most commonly used, vary in the way they are used because these terms are contextualized.

Perceptions

Diverse nations have responded in a range of ways to this debate, usually as part of their wider negotiations surrounding education. In some countries, earlier work on EE seems to have paved the way for ESD and CCE long before those terms became part of national agendas. In Denmark, for example, work in the 1980s led to the development of a radical new approach to dealing with environment and development problems (Breiting, Læssøe et al. 2009b). The central educational goal of this new approach was to enhance students' action competence related to environmental problems (Mogensen and Schnack 2010). The conceptualization of environmental issues also moved from a rather simple focus on identifying environmental problems to one of understanding these issues as the nexus of conflicting interests related to the use of natural resources (Schnack 1998). This new approach emphasized the empowerment of students and citizens, placed human relationships at the core of environmental management and development, and argued that democratic methods are needed to solve problems related to environment and development. These changes implied a re-thinking of the ways in which EE was understood at the time, and so was called 'The New Generation of Environmental Education' (Breiting 1993; Breiting, Hedegaard et al. 2009). It later also proved to be congruent with UNESCO's conceptualisation of ESD, and so assisted in the transition to ESD in Denmark.

Treatment of CCE

The need to address effectively climate change – both through mitigation and adaptation strategies – has been increasingly recognized within both research and policy on EE and ESD. In 2009, for example, a UNESCO policy dialogue document acknowledged that human-caused climate change is a major global issue and argued that addressing it is part of the mandate of ESD. The broader question, however, is whether CCE will be integrated within ESD or will gain the status of an independent and perhaps even competing field.

Tensions exist between content-driven approaches to education and those that build capacity 'to think critically about what experts say and to test sustainable development ideas' (Vare and Scott 2007).

Indeed, the term rarely occurred in policy documents in any countries under discussion. In Singapore, where the idea of ESD is seldom discussed, the subject of CCE is even less commonly dealt with in the education system. In the UK, growing recognition of the need to address climate change has prompted governments to consider how the topic should be covered in national curricula and encouraged NGOs to produce educational resources for use in schools. This has largely taken the form of additions to existing programmes related to environmental issues and sustainable development, however, and CCE as a term or theoretical concept remains relatively unexplored.

This leads us to question the utility of the term CCE, and to speculate on its potential usefulness in future: Is there a need for this term/concept in research, policy and/or practice? Is climate change more effectively addressed through separate educational initiatives (e.g. CCE) or as part of existing

thinking and practice linked to EE and ESD? What are the potential impacts of the introduction/ strengthening of the concept of CCE to existing research, policy and practice? While we cannot answer these questions in this paper, they suggest that more thinking is needed in these areas.

Conceptualization and Policy

So, what do these diverse engagements with the concepts of EE, ESD and CCE tell us about the relationships between conceptualization and policy? It seems common sense that clear conceptualization of key terms is necessary for the development of strong policy. However, contrary to this assumption, unified, consistent conceptualizations of ESD and CCE did not seem to go hand in hand with policy formation in all cases.

Indeed, in some of the countries, diverse and sometimes paradoxical conceptualization of key terms seems to have led to the production of many pieces of policy supporting the implementation of what different groups have deemed EE, ESD and CCE. In Canada, for example, several groups acting at different levels, sometimes even within the same jurisdiction, have been active in producing policy for ESD. Three of these are the federal government, provincial governments and NGOs. Although the federal government seems not to have been actively engaged with ESD and CCE for the past decade, it produced key documents earlier on, which continue to influence the evolution of ESD in the country currently. For example, in 2005, it introduced the Competitiveness and Environmental Sustainability Frame- work (Environment Canada 2005). This policy linked concepts of sustainability, economic development and environmental protection.

Although it was rarely referred to after 2006, it assisted in establishing the premise that economic and environmental success, rather than being at odds, can act complementarily – a position still held by many organisations. Across the country many provincial governments have developed policies to foster ESD within their jurisdictions (e.g. Manitoba Education and Training 2004; Ontario, Ministry of Education 2009). However, the extent of engagement with ESD has been variable, and some provinces have more comprehensive plans as compared to others.

Conceptualization and Practice

While we found the relationship between conceptualization and policy sometimes rather surprising in the four national contexts, we found that between conceptualization and practice almost counterintuitive. Despite the existence of diverse conceptualizations and extensive policies, none of the research teams from the four nations was not able to give any definitive statement about the successful enactment of ESD and CCE at the classroom level. The main reason for this may simply be due to the lack of available research documenting practice. In all the nations, the dearth of research about classroom practice was noted.

In the UK and Canada this seems to be exacerbated by the fact that the field(s) remain firmly rooted in NGO practice, where the focus is often largely on campaigning and awareness raising rather than on learning, and therefore continues to be somewhat marginal to mainstream educational research. Government and other public bodies in the UK, as well as private sector institutions and consultants are also often mainly interested in collecting 'evidence' to support policy-making decisions. This might take the form of assessing the awareness of the general public or particular populations (e.g. university students, young people, etc.) about issues of sustainability and development or attempting to evaluate the impact and effectiveness of particular initiatives. Many organisations therefore tend to see research as analogous with doing evaluations/impact assessments and so often rely on narrowly focused investigations of educational practice (e.g. short-term quantitative surveys). As a result, there is only a limited support for the kind of exploratory or long-term research engagement which might be seen as more valuable within academic arenas.

Such research gaps may also reflect a deeper systemic weakness – a lack of EE and ESD research's influence on policy and practice. This poses challenges both in those fields and in the emerging field of CCE, with many educators, researchers and policy-makers as of yet unsure of how to address effectively climate change through educational interventions. As a result, organize significant questions remain Should CCE independently of existing ESD and EE initiatives and policies. What kind(s) of education and learning are the most appropriate for addressing the complex global challenges of climate change?

Hard Truths about Climate Change Education in Future

First, it is now over a quarter of a century after the agreement of the United Nations Framework Convention on Climate Change (UNFCCC 1992). Article 6 of the Convention established the necessity of climate change action in multiple sectors, including education, training and public awareness (UNFCCC 1992, p.10). Alongside Articles 4—e.g., in 1.i, to 'Promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of nongovernmental organizations'

- 5 (on research and systemic observation)
- 6 (on education, public awareness and training),

The UNFCCC prioritized six key areas of activity: education, training, public awareness, public access to information, public participation, and international cooperation (Figure 1).

Scope	Objectives	
Education	Change habits in the long-term	Foster a better understanding of, and ability, to address climate change and its effects
Training	Develop practical skills	
Public Awareness	Reach people of all ages and walks of life	Promote community engagement, creativity and knowledge in finding climate change solutions
Public Access to information	Make information freely available	
Public Participation	Involve all stakeholders in decision-making and implementation	Engage all stakeholders in debate and partnership to respond collectively to climate change
International Cooperation	Strengthen cooperation, joint efforts and knowledge exchange	

Figure 1. Action for climate empowerment guidelines—scope and objectives (Source: UNESCO and UNFCCC, 2016, p. 3, based on UNFCCC, 2005, Article 6).

Together, these 6 areas for action would be supported primarily through various levels of government tasked with directing and supporting educational standards and provision, public goods and services in the non-formal and informal education sectors,

and last but not least, voluntary action. However, the lack of substantial progress on these tasks and fronts over more than two decades has to be recognized as a key factor in both the frustration felt and deliberations undertaken, which lead to Article 12 of the Paris Accord (UNFCCC 2015, 10). Therein, the key need was restated, namely that: *Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement.*

National Context

In comparing the responses of the nations to ESD and CCE, it is clear that some of the most salient factors guiding the conceptualisation and further development of these initiatives have to do with particularities unique to national contexts. Geographical, cultural and socio-political pressures have shaped stakeholders' understanding of the terms. However, while in principle government policies related to the environment are very much in line with statements from key international organisations, the interpretation and translation of these statements in the national context is often determined by national priorities, challenges, interests and constraints. As a result, very often ESD is understood to relate mostly to environmental concerns and remains labelled as 'EE'. It is in this context that a relative lack of engagement with the concept of CCE, as noted earlier, also becomes understandable in the Indian context.

International pressures

In conjunction with the specifics of individual national contexts, some countries were also significantly influenced in their conceptualisation and actions regarding EE, ESD and CCE by international relationships. This was clearly demonstrated in the Danish context where recent Danish policy related to CCE is largely the result of international pressure. The Ministry of Education's focus on CCE was triggered two years before Denmark hosted COP152 in October 2009. In preparation for the meeting, all Danish ministries were asked to investigate how their areas of work could contribute to national efforts to address climate change. The Ministry of Education designated CCE as an area deserving particular attention in mid-2007. It also worked with the Ministry of the Environment on a number of projects for incorporating it mostly within the context of science education (Breiting et al. 2009). Examples included the creation of resource websites for teachers, climate teaching material for primary and secondary schools, and a mobile unit with a team of teachers and equipment to visit schools.

The pressure of hosting COP15 along with that from NGOs and other key educational stakeholders resulted in the Ministry taking an active and seemingly genuine interest in the UN Decade for ESD. It developed a national strategy for ESD in accordance with the aims of the DESD as well as the UNECE strategy for ESD (UNECE 2005). The Danish strategy for the decade was sent to stakeholders for consultation at the end of 2008 and was published in March 2009. The role of COP15 in advancing Danish ESD becomes clear when we consider the broader historical context. Before the event, official hesitation to fully engage in ESD planning and implementation was grounded in the priorities of the Ministry, which at the time were focused on moving 'back to basics' in core subject areas, and were therefore somewhat in contrast to ESD's interdisciplinary approach. Notably, since the end of COP15, the political establishment in Denmark has largely lost interest in CCE and ESD.

Global Scenario

We have already noted, for instance, that EE continues to be the most widely used term world over. Now given below are some examples to illustrate this.

Singapore: In Singapore, while the concepts of CCE and ESD remain marginal to discussions. The reasons for this have much to do with its unique national context.

Singapore is a physically small country with a population density of 6489 people per km2 – one of the highest in the world. Environmental concerns are therefore a highly important consideration to its development and long-term survival. Singapore is land-scarce, water-short and energy-poor in a context of high consumption of these resources. Taking water as an example, Singapore is dependent on foreign sources for almost 50% of its daily water supply, and this dependence has strategic implications for the government (Goh 2005). Principles of sustainable water management were therefore adopted from the late 1980s not out of choice, but of necessity. The Ministry of Education also understands that this issue is important for its citizens to appreciate and hence it is incorporated within the curriculum, particularly in social studies, sciences, geography, and civics and moral education. Pupils from a young age are imbued with a sense that water should be valued and consumption should be reduced. Further, the presence of a strong, unitary government has also allowed education to be used as the central vehicle through which issues of nationhood and the environment have been introduced into curricula in Singapore.

Wales: In Wales, for instance, climate change is a key theme within the national curriculum and educational resources produced by the Assembly Government, which uses the term Education for Sustainable Development and Global Citizenship to describe its approach (see Welsh Assembly Government 2008). By contrast, in England the change in government in 2010 resulted in significant changes to the national curriculum, including questions about the ways in which climate change should be addressed – or indeed whether it should be addressed at all (cf. Shepard 2011).

Canada and Denmark: Similarly, in both Canada and Denmark, the issue of climate change is often mentioned in contemporary educational policy documents. However it is clear that climate change is often viewed as an aspect of the existing subjects of EE/ESD and/or science education, rather than a stand-alone concept (as in the case of CCE). In Denmark, the government's main focus has been on linking climate change to innovations in science education, rather than on developing a separate conceptualisation of CCE for inclusion within the curriculum. This may have in turn made it more difficult for teachers of other subject areas to see the importance of teaching about these issues as part of wider EE/ESD practice (Breiting et al. 2009). Similarly, in the province of Newfoundland and Labrador in Canada, recent policy documents have named climate change as a major challenge facing the province, and have identified it as a priority to be dealt with as part of EE programs (Newfoundland and Labrador, Department of Environment and Conservation 2005). In neither of these countries, then, is CCE currently treated as a subject on its own, nor does it seem likely to become one in the near future. Rather, it has been integrated – to various degrees and in diverse ways – with existing programmes and initiatives.

Higher Education Role: Case of Symbiosis International University, Pune, India

Environmental issues, development concerns and sustainability have become a major interest area for society as critical issues for economic growth and societal development. The recent Rio+20 summit in 2012 has strengthened the need for building sustainable development as an integral part of educational institutions through integrated learning and use of innovative pedagogical methods including the internationalization of educational systems (Rao, Patil, Bhat and Kulkarni, 2015). The university emphasized and laid focus on sustainability as a core vision and its concepts in policy and practices by implementing a unique standardized curriculum integrating various levels of sustainable development by building curriculum in key disciplines like energy, environment, infrastructure, climate change, global governance and corporate sustainability. Initially they did the preliminary assessment of the sustainability operations of the University through

quantification of its energy, water consumption patterns and other initiatives. Then used pilot student driven projects to describe sustainable development in practice. In this process, they addressed some of the key issues and challenges in building environmental aspects as a part higher education policy and as a sustainable practice across constituent institutions of the University.

Recommendations

Sustainable university research and development work has explicit normative-ethical parameters (the 'sustainable development' imperative) as well as an explicit normative-ethical mission: institutional transformation toward sustainability. Its researchers are also its practitioners; the researcher-practitioner cannot separate her-/himself from the effects or implications of her/his research, as in many other forms of science. Hence, it is crucial to:

- Recognize a university as an open, dynamic system with the potential to learn, evolve and change (Albrecht, Burandt and Schaltegger 2007; Gough and Scott 2007)
- University must reach across administration and academe as subsystems to target both subsystems within the university system to realize the sustainable development imperative (cf. Adomßent, Godemann and Michelsen 2007)
- Work toward cementing sustainability principles in university governance and administration
- Establishes research structures and opportunities that facilitate multi-, inter- and transdisciplinary sustainability-related research, and tackles research questions within sustainability in higher education research as an aspect of sustainability sciences
- Engages researchers who critique scientific endeavours and their own professional conduct toward effective research structures and collaborations
- Offer formal and informal sustainability learning opportunities on campus and reflects on its curriculum and teaching
- Provides innovative, progressive sustainability education in the form of multi-inter, and transdisciplinary project-based experiential learning
- Develops the potential of the campus as a learning laboratory, toward institutionalizing a sustainability life-world (informal learning opportunities)
- Aims to improve operational sustainability performance, by designing and implementing interventions that reduce the institutional ecological footprint in conjunction with highlighting the social, economic, and cultural dimensions of sustainability; such interventions are empirically monitored and evaluated;
- Recognize the importance of complementary technical-behavioural sustainability interventions, and uses tried behaviour change methods, such as social marketing or community-based social marketing to facilitate behaviour change
- Designs participatory structures, for instance via multi-stakeholder processes or two-way dialogues, to enable democratic communication between researchers and researched – toward high levels of acceptance, buy-in and engagement, for on- and off-campus community members
- Committed to knowledge generation, knowledge transfer and capacity-building for sustainability, as evidenced in publications, conference presentations, and community-based dissemination strategies;
- Works toward sustainable education on the higher education policy level and seeks to realize its societal commitment for sustainable futures, by seeking to influence state/provincial, national and international public and educational policy as well as the higher education system/s toward preferred, more sustainable alternatives.

Thus, sustainability in higher education initiatives, which display all these elements of sustainable university research and

development, remain uncommon. The least reason is a capacity threshold: it takes a certain size of research team and number of faculty collaborations to work in such way, on all these aspects and levels. The many exceptional greening the campus programs and initial initiatives worldwide each contribute in singular facets to sustainable sustainability in higher education.

Future Ahead

- Need for empirical evidence from cases about youth involved in and impacted by environmental awareness and action projects
- Attitudes and competencies leaders need to guide, support or facilitate through climate change education to catalyse and sustain resilient communities. Examples of what constitutes a successful climate change education project in its effect on awareness, resilience and future action.
- Educational systems and structures that contribute to dynamic learning environments while respecting different physical, ecological, cultural, political, economic and social realities and combining perspectives to create unique outcomes suited to specific communities and situations. Specific roles of educators, NGOs, scientists, pre-university and university instructors, businesses and environmental researchers.
- Use effective technologies effectively to enhance environmental educational collaborations and interactions between researchers, communities, academics and youth.
- Need for new perspectives on climate change awareness and education from research for academics, practitioners, educators and governmental leaders.
- Need for evaluating scholarly findings through the voices of youth to evaluate effectiveness of theories and approaches.

Conclusion

The discussions above highlight the range of factors that have an impact on the conceptualisation of central ideas surrounding EE, ESD and CCE and further how these latter can impact policy and practice across national contexts. The chapter entails a discussion on how EE has become inextricably entangled with ESD, and can sometimes even act as a barrier to efforts to promote the latter. We also questioned the relative usefulness of the term CCE and speculated about its future utility since in practice CCE is often treated as an aspect of EE or ESD, rather than as a separate concept. Thirdly, we discussed how socio-political factors like national contexts and international pressures could act to shape stakeholders' ideas about an issue and drive its further conceptualisation. With respect to the relationships between conceptualisation, policy and practice, the discussion bought up several rather surprising points. Contrary to the common-sense view, unified, consistent conceptualisations of ESD and CCE may not be necessary for policy formation. Despite on-going debates about the conceptualisations of key terms, all countries need extensive policy supporting the implementation of educational initiatives linked to environmental concerns and/or climate change. In many cases, policy has been developed within individual jurisdictions based on their originators' own interpretation of key terms. Denmark's experience with COP15 clearly demonstrates how international pressures can drive policy formation and how efforts can falter when such pressure is removed.

Taken together, the points discussed in this chapter raise some disquieting questions. What do us, as educators and researchers, know about policy-making processes either internationally or nationally for new educational initiatives, and how does this impact on our engagement within them? What lessons might researchers in diverse contexts learn from one another about these engagements? More broadly, how are conceptual problems treated during policymaking processes? How do policies influence practice? How does educational research fit in? Perhaps most fundamentally, what are the potential roles of educators and researchers in these processes – to shape discourse, to engage directly in policy

creation, and/ or to document and analyse existing practice?

Thus, there is an urgent need to engage actively in these kinds of debates, for sound educational responses to the global social and environmental challenges that we all face. In addition, sustainability represents an opportunity for the renewal of old Indian education systems founded on cooperative principles and values rather than merely based on competitive and a predatory view of the world. Educating for sustainability means educating for the emergence of a different, possible world.

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MITIGATING WATER STRESS THROUGH CLIMATE CHANGE EDUCATION

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Abstract: *In this survey, an effort is made to analyse the expert opinion collected from the Managers/Assistant managers of water treatment plants based about climate change and its impact on water resources in India. The data is collected from 32 respondents having minimum of 10 years of work experience and to collect data interview method is adopted. The findings revealed that the water demand in India will reach 1.5 trillion cubic meters in 2030, while India's current water supply is only 740 billion cubic meters. Further, water scarcity will cost India 6 percent of its GDP, if the Government continues to mismanage the water resources. The solution to this burning issue is to create awareness among the people about water resource management. Good water infrastructure facility is required to provide adequate supply of water for the future generations.*

Key words: Water resource management (WRM), Wastewater filtration (WWF), Climate change education (CCE)

Introduction:

It is a known fact that Climate change, caused by emissions from industries and other human activities, is making the world warmer. To be more specific, the global surface temperature was increased by +0.8 degree Celsius up to 1900, later on increased by 1 degree Celsius. According to IPCC (Inter governmental panel for climate change) report 2018, global warming likely to increase by 1.5 degree Celsius by 2030. Even though world leaders agree on the causes of climate change, differing views do exist on ways to mitigate its adverse effects. So it has become need of the hour to implement new measures immediately to mitigate the risks. Otherwise, global warming may increase by 2 degree Celsius.[3] The above data conveys that rising temperatures with lower rainfall may lead to severe water stress at global level.

Significance of the study:

No water = no life. This statement conveys that Water is a limited natural resource and most precious element for all living beings on the planet. We can live without love but not without water. This quote clearly indicates the importance of water for survival of living beings on the planet.

It is a fact that 70% of earth's surface is water, 75% of human body and 90% of human blood is water too. Again the water that is there on earth, 97% of earth water is salt water, which we find in seas and oceans, and 2% is icecaps and of the remaining 1% of fresh water, only 2% is used for drinking purpose and 98% is used for agriculture and industrial use.[6] Experts say that the next major war in the world will be not war over oil but it will be war over water.

To set right this burning issue, in 1993 the United Nations General Assembly designated 22nd March as the first **World Water Day**. From this date onwards, International World Water Day is held annually on 22 March to convey to the mankind that A DROP OF WATER IS WORTH MORE THAN A SACK OF GOLD TO A THIRSTY MAN.

The theme for World Water Day 2019 is 'Leaving no one behind', which means that water is a basic need that must be provided to all the citizens and this should be an obligation on the part of the government. Again, to ensure the availability and sustainable distribution of water to all by 2030, advanced countries can support developing and under developed countries in

water- and sanitation-related activities and programmes, including water harvesting and wastewater treatment. [7].
Even today billions of people are still living without safe water. Water is becoming both a scarce and a crucial resource and this problem is escalating at an alarming rate. Therefore, a study on climate change and its impact on water resources has become the need of the day.

Review of Literature:
The overview of the related literature on water resources management is enunciated below:

A. Global Scenario
According to UN report 2018, globally 1.5 billion people use contaminated water and almost 31/2 million people die every year because of deterioration of quality in surface and ground water. Again, every 21 seconds, one child dies due to water related illness. Fresh water animals are disappearing five times faster than land animals. Over 60% of the wetlands in the world have been destroyed in the past 100 years. By 2050 1 in 5 developing nations will face water shortage.[6] Further, Asia has maximum number of polluted rivers than anywhere else in the world and it is estimated that current wastewater treatment capacity is 70% of the generated wastewater in high-income countries and only 8% in low-income countries.

As Singapore is internationally recognised as a model city for integrated water management, an attempt has been made by the authors to compare water resources management in India and Singapore and authors found that Singapore has 36 artificial lakes, 20 water treatment plants and 32 major rivers for the population of 5.64 million. Whereas India has India has 15 artificial lakes, 816 water treatment plants and 40 major rivers for the population of 1.35352 Billion. Singapore gets 20% of its water supply from rainwater collected in lakes and dams, whereas, India uses only 10% of annual rainfall for drinking purpose and the remaining goes unused into oceans. So, India needs Good water infrastructure facility to provide adequate supply of water for the future generations.

B. Indian scenario

According to a World Bank Study 2018, nearly half of the population in India lives in places that are likely to become severe climate hot spots by 2050. Changing rainfall pattern due to climate change could result in extreme water stress and would cost up to 6% of the gross domestic product (GDP). Yale University conducted a research on climate change and pointed out that 65% of the Indian population is not aware of climate change.[8] Yet India has no national study on the impact of climate change, although about 600 million people are at the risk from its effects.

India has 4 per cent of the world's water resources but it is the home to 18 per cent of the world's population. The water scarcity is mostly due to excess population growth, which is expected to increase to 1.6 billion by 2050. Studies show that 200 million hours per day is spent by women and girls for collecting water and average availability of water is shrinking steadily. Water Aid's report, 2018, conveys that in the list of 122 countries rated on quality of portable water, India ranks a lowly 120th place. It is estimated that by 2025, India will become a water-stressed nation.[1]

The World Bank report, 2018 show that in India 163 million are living in rural areas without access to clean water. Currently, two lakhs people die every year due to inadequate access to safe water. Overall, one in every 4 hours dies on account of consumption of bad water.[2]

According to United Nations Educational report, 2018, India is the biggest consumer of groundwater in the world. But, the problem is that out of 6, 30,000 villages in India, 60% of villages are affected by chemical contamination of water. The report conveys that the quality of water in these areas is affected due to the urbanisation, industrialisation and human waste flowing into water sources and there by polluting the

groundwater.[3]

The ministry of health and family welfare has identified 8 states (Andhra Pradesh, Chhattisgarh, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, and Uttar Pradesh), where 75% of bore wells was contaminated. A survey conducted revealed that there are 208 lakes in these areas but 85 per cent of these lakes have water that could neither be used for agriculture nor industrial use. People in these states suffer from lungs, skin, kidney, and liver problems and Diseases such as cholera, blinding trachoma, malaria and dengue found to be more common in these areas. Further, due to water shortage, the wheat target lowered from 22million tons to 19 million. This in turn resulted in poverty and retrenchments. [4]

In 2016, the UGC introduced a six-month compulsory course on environment studies for undergraduates from all disciplines, but in the curriculum, climate change is very briefly reflected. So it has become cry of the hour that GOI need to invest more on climate change education.

Experts are of the opinion that to measure the impact of climate change on crop production, we need have good climate models at the district level. For instance, maize is grown in 300 districts in India. We need to run these climate models for 300 districts and see where the decline will be more or less. This kind of assessment does not exist right now, because we do not have district wise specific data.[6]

Information relating to climate change and its impact on different crops can be uploaded on the government website. Some research institute wants to use the data; they can be given access to that data directly. Further, if such kind of data is given to the farmers, they can use it, while building water storage structures.[9]

We know that to tackle this burning issue, there is a need to build a network of research institutions throughout India. This networking should be done under a national program and there is a need to focus on this issue like a mission. We still do not have that kind of a mission approach.[2]

Statement of the problem:

Water demand in India will reach 1.5 trillion cubic meters in 2030, while India's current water supply is only 740 billion cubic meters and 62,000 million litres of waste water is generated per day in India, but only 8% is recycled [8]. Again, Water scarcity will cost India 6% of its GDP, if the Government continues to mismanage the water resources. Therefore, the present study is undertaken, wherein an effort is made to find the answer to the following questions:

1. What are the major reasons for water stress in India?
2. How to overcome water stress in India?

Methodology:

A phenomenological investigation was undertaken for the purpose of this study, as it facilitates to understand the perception of the managers/ assistant managers of water treatment plants about water resource management.

Data Generation

The researcher developed open-ended interview schedule to gather the perceptions of the managers/assistant managers of water treatment plants about water resource management in India.

An in-depth, open-ended interview was conducted, as this is the most frequently used method in phenomenological research.

For the purpose of collecting information (viz., experiences, feelings and memories), the purposive sampling method is adopted to select the respondents.

Profile of the Respondent Managers/Assistant managers:

Sl No	Age	Gender	Total Work Experience	No. of Employees	Company Name
1	36 32	Male Female	14 10	2	**Primus Environ** No 3, Sri Lakshmi Nivas, 5th Cross, Kasturi Nagar, Ramamurthy Nagar, Bangalore
2	33 33	Male Male	10 10	2	**Seamark Hi Tech Products** No.797, 1st Floor, 1st Cross, 12th Main, Hal 2nd Stage, Indiranagar, Bangalore - 8
3	40 31	Male Male	16 10	2	**Dexter Water Tech** No.20/10, 5th Main, 1st Cross, Gangappa Block, Rt Nagar, Bangalore – 560032
4	38 35	Male Male	16 13	2	**Safe Water Technologies** No.157, 4th Main, 4th Cross, NGEF Layout, Sanjay Nagar, Bangalore – 560094
5	41 30	Male Female	16 10	2	**Thermax Limited** 6. No.1 Rng Pallazzo, 1st Floor, South End Street, Kumara Park East, Bangalore - 560001,
6	30 32	Male Male	10 11	2	**Waste Water Recycling (STP)** 21, 9th Main, Koramangala, Bangalore – 560034
7	43 35	Male Male	18 12	2	**Ecosoft Water Technologies** 33/1, 9th main, Bannerghatta Road, Bangalore – 560076
8	30 35	Male Male	10 12	2	**Insulac Technologies** No.1, 1st Floor, Sarakki, Jp Nagar 1st Phase, Bangalore – 560078
9	30 32	Male Male	10 11	2	**Blue Waves** No.1/2, 3rd Flr, Ramakrishnappa Lyt, 3rd Crs, Raj Mahal Vilas 2nd Stage, Bangalore
10	35 33	Male Female	13 10	2	**Four Square Engineering** No.1293/1, Begur Main Road, Begur, Bangalore – 562122
11	36 35	Male Female	13 12	2	**PAI & PAI Chemicals India Pvt Ltd** No.438/1, 1st Block, 20th Main Road, Chord Road, Rajajinagar, Bangalore – 10
12	40 31	Male Male	16 10	2	**Hydro Chemtech Pvt Ltd** No.3618/26, 3rd Cross, Gayathri Nagar, Bangalore – 56002
13	38 35	Male Male	16 13	2	**Hallmark Water Designs** No.174, Mariyappa Building, Velankani Road, Thogur, Electronic City, Bangalore – 560100
14	36 32	Male Female	14 10	2	**Alpha Associates** # 1, CMH Road, Ulsoor, Bangalore – 8
15	36 32 38 34	Male Female Male Male	14 10 16 12	4	**White and White Enterprises** No.65/1, 5th Main, 3rd Stage, 3rd Block, Sanegoravanahalli, Basaveshwara Nagar, Bangalore – 79
	Total			32	

For the purpose of present study, 32 managers/assistant managers having minimum of 10 years of work experience (friends, relatives and neighbours) in water treatment plants were selected randomly.

Research Findings:

Summary of the findings is as follows:

Research question-1: What are the major reasons for water stress in India?

Sl. No	**Managers Perceptions**	**Response (%)**
1	Agriculture is the main occupation of the people in India and therefore the consumption of water for irrigation is high. A traditional technique of irrigation causes maximum water loss due to evaporation, drainage, percolation, water conveyance, and excess use of groundwater. As more areas come under traditional irrigation techniques, the stress for water available for other purposes will continue.	23 (71%)
2	Disposal of industrial and human waste is severely shrinking the availability of potable water. To be more specific, Leather and chemical industries are responsible for major water pollution. Every day 2M tons of human waste is disposed into water.	30 (93%)
3	A running toilet can waste up to 200 gallons of water, While brushing the teeth, running the tap can waste 4 gallons of water, A tap that drips once every second can waste 30 litres of water each day. Over 92% of used water today is not processed. Therefore, such water is not used again.	23 (71%)
4	Very often, we see water leaking in our homes, in public areas and colonies. A small steady water leak can cause a loss of 226,800 litres of water per year!	28 (87%)
5	There are 816 STPs (sewage treatment plants) in India. But, 70% of Indian sewage treatment plants are not working due to high running cost	23 (71%)
6	The water quality is also deteriorating; municipalities are unable to maintain ageing water and waste water infrastructure due lack of personnel with requisites skills	28 (87%)

Source: Primary data

The findings presented in the study convey that the quality of water is affected due to the urbanisation, industrialisation and human waste flowing into water sources. Further, the water scarcity is mostly due to excess population growth. Very often, we see water leaking in our homes, in public areas and colonies. Over 92% of used water today is not processed. Therefore, such water is not used again.

Research question-2: How to overcome the water stress in India?

Sl. No	**Managers Perceptions**	**Response (%)**
1	Artificial Lakes and Dams should be constructed to collect every drop of rain water that falls on India.	31 (96%)
2	If all male members of the house use the 'water free urinal' instead of pulling the traditional flush, we can save around 25,000 litres of water, per home per year. This must be made mandatory by law and followed up by education and awareness both at home and school.	30 (93%)

3	More water is wasted during dish washing at home. We need to change our dish washing methods and minimize the habit of keeping the water running. For instance, people in urban area can get a dishwasher**,** which uses less water than washing dishes by hand. Experts say that hand washing of one load of dishes uses 60 litres of water, whereas water- and energy-efficient dishwaters use as little as 12 litres. A small step here can make a significant saving in water consumption.	28 (87%)
4	Recycling waste water is extremely sustainable, if managed in a decentralized fashion, since the source and user would be in close proximity. For instance, transporting waste water to a remote unit for treatment and back to the user necessitates huge expenditure by way of pipelines, pumps, electricity and maintenance. The current style of recycling water is predominantly designed in this manner, and understandably, not producing much result.	30 (93%)
5	If every drop of recycled water is reused for the maintenance of public parks, cooling water for power plants, toilet flushing, dust control, construction activities, concrete mixing, artificial lakes, and productivity of water supply can be increased not just by 10% or 20% but by 100%.	31 (96%)
6	Presently we are depleting our ground water resources. So, we need to recharge them by RWH facility. Government should check at regular intervals whether all the independent houses and flats have RWH structures. If not necessary action should be taken.	32 (100%)
7	India needs more number of water treatment plants	31 (96%)
8	Turn off the shower tap while soaping. Use a tumbler when brushing your teeth. Do not throw the food under running water. Run the washing machine only on a full load. Collect rinse water from the washing machine for flushing the toilet or mopping the floor. Turn off taps tightly to ensure they do not drip. Do not leave the tap running when not in use. Check for leaks in flushing cisterns, pipes, taps, etc. and repair them immediately to prevent water wastage.	28 (87%)
9	The planning of water resources need to be done considering the factors like rainfall, surface run off, earth quake as well as evaporation and transpiration.	30 (93%)
10	Surface water runoffs may be moderated by erecting structures to dam or river diverts and store water in a natural lake or reservoirs. Also reducing river discharge into the sea to zero is abhorrent to the environmentalists	31 (96%)

Source: Primary data

Thus, the above excerpts reveal that by improving the sewage systems, we can prevent water scarcity. Recycling waste water is extremely sustainable, if managed in a decentralized fashion, since the source and user would be in close proximity. Micro-irrigation techniques such as drip and sprinkler irrigation should be used to save water. A small step here can make a significant saving in water consumption.

Implications of the Study

Practical implications:

As 2% of the water on earth is suitable, it is important to ensure that water resources are not polluted due to excessive use of fertilizers and pesticides, urbanization and industrialization. Therefore, both surface and groundwater should be regularly monitored for quality and providing drinking water to all human beings and animals should be the first priority.

De Nora India Limited invented De Nora electro chlorination system to remove the bacteria and viruses from water. This system is approved by WHO & the UN. Around

1300 units are already in operation from Kashmir to Kanyakumari. The Operating costs are very low i.e .10 to 1.00 paisa per litre of water. **De Nora electro-chlorination system** can also be used for general **Sanitation** in Agriculture, Food Processing, Hospitals, Hotels, Commercial & Residential buildings.

Electro chlorination is an Eco-friendly technology. It does not harm the environment. It is also safer for the operators of the chlorinators. Electro-chlorination uses common salt and electricity as raw materials. One million litres of water require only 10KW of electric power and 5 Kgs of common salt for sanitizing. Solar powered units are also available, as many parts of the country do not have regular power supply.

In India most of the water is direct or indirect rain water. The monsoon fall is very definite, about 100 days per year. 50% of water falls in 35 days and the balance in 65 days. Hence Rain Water Harvesting is a must. This is a low technology solution and needs to be practiced in all the 9,000 municipalities and 630,000 villages of India. Presently we are depleting our ground water resources. We need to recharge them during these 100 days of rainfall by RWH.[5]

Methodological implications:

Research on Water resource management is less investigated empirically. Therefore, longitudinal study on water resource management and its short term and long term impact on the quality of life of the people should be conducted. In Indian context, such type of study may throw new light on water resource management.

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A TRANS-DISCIPLINARY LEARNING APPROACH TO COMBAT CLIMATE CHANGE MORE EFFECTIVELY

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Introduction:

Climate Emergency is Oxford dictionary's word of the year 2019. It refers to "a situation in which urgent action is required to reduce or halt climate change." The significance is clear from an article in Times of India (December 13,2019) according to which 'Oxford Dictionary chose its word from an all-environmental shortlist that also included "climate-action", "climate denial", "eco-anxiety" and "extinction". The global actor, Leonardo DiCaprio said "Climate change is real. It is the most urgent threat facing our entire species and we need to work collectively together and stop procrastinating". Another young actor Greta Thunberg spoke thus "We are in the beginning of a mass extinction and all you talk about is economic growth. You've stolen my dreams. How dare you!" Today the awareness about climate change has moved beyond academicians.

Climate change is deemed to be one of the major environmental issues facing the world today. It is essential to know why this problem has grown in magnitude and how well it can be tackled to mitigate the threats from it. According to National Geographic Society, climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over a very long period. The encyclopaedia says climate change is a long-term shift in global or regional climate patterns. Often the word climate change refers specifically to the rise in global temperatures from the mid-20th century to present. It is the long-term alteration of temperature and typical weather patterns in a place.

Before analysing climate change, it is necessary to what is meant by climate? The climate of an area includes seasonal temperature and rainfall averages, and wind patterns. Different places have different climates. Unlike weather, climate is measured over a long period of time.

Climate change is and has been a continuous process on Earth, which is clearly seen from the geological records. But then why this recent outcry on the issue? Well, it is the rapid rate and the magnitude of climate change occurring now that is of great concern worldwide. The raging wildfire in Australia which perhaps led to extinction of several local species is the most recent of several such incidents which calls for a rapid action to protect and nurture our ecosphere.

The Climate Change Performance Index 2020 results indicate that no country has been able to score well enough in all the index categories as a result of which the top three ranks remain empty this year also. The Index looks at the main regional differences in climate protection and performance within the countries. The CCPI 2020 monitors the development of all greenhouse gas emissions of the evaluated countries, the other parameters being energy use, renewable energy and climate policy.

Climate change being too big in space and complexity, the methodology adopted for this paper is conceptual research. All the required data has been collected through external desk research. Given the global nature and spread of the problem, online desk research was considered, by and large, to be a very effective data collection tool. Various search engines were used to analyse the problem of climate change, the challenges posed by it and also to study if and how trans-disciplinary approach can become a tool for decimating the adverse effects of climate change.

This paper aims to

1. Understand the current scenario associated with climate change.
2. Study the indicators of climate change.
3. Analyze the probable causes for climate change.
4. Examine how trans- disciplinary learning can be an effective tool in combating climate change.

Current Scenario:

The scientific community is certain that the Earth's climate is changing because of the trends noticed in the instrumented climate records and the changes observed in physical and biological systems. The instrumental record of climate change is derived from thousands of temperature and precipitation recording stations around the world.

The evidence of a warming trend over the past century is unequivocal. Many types of instrumental records point to a climate warming trend. According to the Independent, recent studies reveal that climate change led to a deadly ocean heat wave which struck a quarter of the oceans in the year 2016. This resulted in a mass of hot water in the Pacific (nicknamed 'the Blob') and this was linked to the death of marine animals and the devastation of ecosystem. The Associated Press also published this online 'Heat wave called 'The Blob' kills off around one million birds in the Pacific Ocean'. Though not clear of reasons for the large scale death of these animals at that time, today it is more or less pinpointing towards climate change! A team of Australian scientists have concluded that the 2016 heat wave was influenced by anthropogenic or human induced climate change.

'US deserts burn in triple digit temperatures as California and Montana hit by wildfires.' (Scott Sonner, September 2017). 'According to scientists, heat waves kill in 27 different ways'(Alex-Matthews King, November 2017). 'Hundreds of flying foxes which are considered keystone species, are being burnt alive in Australian heat wave. (Aline Polianskaya, January 2018). These were news articles from the Independent. According to BBC, Australia has always had bushfires, but this season has been a lot worse than normal. The scientists believe climate change (Indian Ocean Dipole) is the cause for the recent 2019- '20 devastating bush fires in Australia .Christopher Dickman, Professor of Terrestrial Ecology at the School of Life and Environmental Sciences, the University of Sydney said this about ecology disaster in Australia "We have actually known for some time now that through climate change southern Australia in particular would become hotter and drier. A drought began in 2018, which went on through all of 2019.There were also really hot conditions towards the end of 2019, which meant that everywhere was just tinder-dry. Lightning strikes then just allowed the bush to burn really quickly." More importantly as was reported in the Sunday Times of India on January 19,2020, he had this to add "Those effects were predicted by several climate change models, including one particular model in 2008, which predicted exactly the drying effect with the increased heat conditions. It even predicted fires of considerable severity would start to be seen in 2020- that's where we are now". Renowned wildlife photographer Joel Sartore is of the view that millions of species are facing new challenges because of climate change. He cites the simple example of the polar bear which need sea ice to hunt seals and as that sea ice melts away, they and their babies starve to death. He, like many other experts stressed on this fact that "it is a folly to think we can doom millions of plant and animal species to extinction but we'll be just fine-it won't work that way".

The Arctic is warming at more than twice the average rate of the rest of the globe — a phenomenon known as Arctic amplification — and it is losing sea ice at a staggering pace. This finding published on 20 January 2020 could help to explain the disproportionate toll that climate change has taken on the region, an effect that has long puzzled scientists.

A study by scientists which was published in the bulletin of the American Meteorological Society explores further the relationship between recent heat waves in south east Australian seas and anthropogenic climate change. Dr.Eric Oliver of the University of Tasmania had earlier explored the causes of this heat wave. He and his team had concluded that undersea heatwaves were 53 times more likely due to human induced factors.

Still more disturbing is the finding of another recent study which was funded by the National Oceanic and Atmospheric Association (NOAA) and published in the journal Science of Total Environment. It has led to the discovery that the Pacific Ocean's increasingly acidic water is dissolving the shells of newly hatched Dungeness crabs.

On January 30.2020, The New York Times reported 'Scientists in Antartica have recorded, for the first time, unusually warm water beneath the Thwaites glacier which helps to keep the much larger West Antarctic Ice shelf stable'.

Need for the study:

Indeed, the Government, at all levels, as also international bodies have been continuously working on reducing climate change and the adverse impacts of it. The World Bank is building on a data base about the impacts of climate change in order to develop a comprehensive and multi-sectoral approach to address it! Most of the countries have set up committees, developed action plans, and allotted funds to address the issue.

But all is not well. There seems to be a lack of political will. Many countries are handling climate change as a fringe issue with absolutely no sense of urgency. At the recently concluded global Climate Summit in December 2019, many developed countries were side lining the issue with some even denying anthropogenic climate change. Today we know Australia had to pay for not heeding the warnings of climate change made over a decade back! In fact, in 2011 Australia had introduced carbon tax basically to control emissions in the country. But this was in place only for a short while as it was repealed in 2014. The growing global stalemate on this crucial problem makes it necessary for everyone to contribute to mitigate climate change. This could well be an opportunity for India to take the lead in solving this intricate global problem. The fact is that no country will want to meet the challenge of climate change at the cost of its economy despite knowing the importance of a sustainable green environment.

According to the Oxford dictionary, the use of the term "climate emergency" increased by 10789% over the previous year. Awareness has increased greatly but a huge gap still exists between awareness and response!

The Climate Change Performance Index 2020 results indicate that no country has been able to score well enough in all the index categories as a result of which the top three ranks remain empty this year also while the fourth position is held by Sweden. The Index looks at the main regional differences in climate protection and performance within the countries. The CCPI 2020 monitors the development of all greenhouse gas emissions of 56 evaluated countries and the European Union, which are together responsible for more than 90% of global greenhouse gas emissions the other parameters being energy use, renewable energy and climate policy.

This problem is more relevant for India. Why? India with its large population has a greater demand on the natural resources like water and simultaneously a greater impact on the depletion of non-renewable resources and damage to the environment through pollution. All this combined with the lack of an effective environment protection policy makes the problem a more serious one.

This conceptual paper will hopefully contribute towards developing a knowledge base and solutions for slowing down climate change.

Indicators of climate change:

The long-term effects of climate change which scientists had predicted long back , is now becoming a harsh reality ,be it in the northern or southern hemisphere of the globe.

The physical and biological changes that confirm climate change include

a. **Global warming** is considered to be one of the most prominent effects of climate change. A finding published recently by Kevin Krajick of The Earth Institute at Columbia University on January 2020 says that half of all Arctic warming and corresponding sea- loss during the late 20th century was caused by ozone –depleting substances. Former UN Secretary Kofi Annan had said "Global warming must be seen as an economic and security threat".

b. **Faster retreat in glaciers around the world**
A report in Skeptical Science.com says that according to glaciologists, globally the glaciers are losing ice at an extensive rate. Though there a very few which are growing, 90% of the glaciers are shrinking worldwide. This retreat of glaciers poses a very serious problem for millions of people and animals who rely on glaciers for water and in some cases, even food.

c. **Decrease in sea ice**
Changes in the amount of sea ice can upset normal ocean circulation which can lead to changes in climate pattern itself. Over the past 40 years the area covered by ice has shown a dramatic decrease. The yearly cycle of build-up and melting of Arctic sea ice is one of the earth's vital signs and a key climate variable monitored by scientists.

d. **Increase in heat waves**
Global warming is increasing the frequency, duration and intensity of heat waves. In fact, extreme heat is found to be the deadliest form of extreme weather in the United States causing more deaths than hurricanes and floods combined. What were once very rare events have today become a common event.50 years back heat waves were almost unknown! Daisy Dunne had this report published on August 2, 2019 going by a study conducted on heat waves in Europe- "Climate change made Europe's 2019 record heat wave up to '100 times more likely'."

e. **Increased flash floods**
There is an increased risk of untimely flooding which is occurring presumably because of climate change. There is an alarming increase in the frequency of flash floods. India especially the small state of Kerala which used to experience rains for almost half a year has become the most recent prey of climate change. Flash floods in August 2018 had caused devastating landslides and washed away human settlements even as people were watching! It literally had the entire state under deluge. The extent of damage was so huge that it was termed as a National Disaster.

f. **Increase in permafrost thawing**
Permafrost is a thick subsurface layer of soil that remains below freezing point throughout the year and occurs mainly in the polar regions. According to a new study published on February 4, 2020 in the journal Nature Geoscience, the ice that holds the soil together is melting causing massive sinkholes and collapsing of hillsides.

g. **Decreased water reserve especially in semi-arid regions**
Climate change may have many impacts on water supply. Some may be beneficial like when there are

rains. But there may be adverse impact also like depleting water reserve. The situation in some arid and semi-arid regions is so grave that Governments have banned the construction of borewells and in some places even new apartments.

h. Increased intensity of winds and storms

Global temperature rise has resulted in increased occurrence and intensity of dust storms and winds across the globe. Mr. Chandra Bhushan, Deputy director general at the centre for Science and Environment had, citing studies from around the world said "Climate change is intensifying all extreme weather events". IMDs National Weather Forecasting Centre head K. Sathi Devi had said in 2018 "severity of thunderstorms and dust storms was on the higher side as compared to previous years."

i. Extreme droughts around the world.

Climate change increases the odds of increasing droughts in many parts of the world. It is interesting to note that while climate change increases precipitation in some ares, there are places where it leads to drought. Climate change affects a variety of factors associated with drought.

j. Irregular flash floods

In some places marvels of human engineering have done irreparable damage to the ecosystem. Illegal mining is another major reason attributed to occurrence of flash floods.

k. Increased wild fires around the globe

Climate change and deforestation increase the risk of wildfires across nations. Though several reasons could be listed for wild fires, one prime reason is said to be the warmer ocean temperatures. Huge bushfires have been burning in Australia for months!

l. Rising sea levels

When the ocean gains heat, the water expands and sea level rises. Global warming is causing the sea level to rise in two ways. It is the combination of meltwater from glaciers and thermal expansion of sea water.

m. Outbreak of infectious diseases especially after natural disasters

Climate change and infectious diseases - a partnership made in hell? This was the question put forward by Srimathy Sriskantarajah, Associate Publisher at BioMed Central in her blog. This is especially so after natural disasters like floods.

Causes for climate change:

There could be a whole host of factors responsible for the radical changes in climate. Though we don't really understand it, for every known cause, there may be several others unknown to mankind! The known causes can be classified as natural and unnatural causes. The unnatural are mostly man-made causes and are said to be anthropogenic.

Natural causes:

These are all the lesser known causes which are uncontrollable and not much can be done to control them. Some of the major natural factors which can cause climate change are:

Global warming

Over the past 50 years, the average global temperature has increased at the fastest rate in recorded history. And experts see the trend is accelerating:

Volcanoes

Though a volcanic activity lasts only for a few days or weeks, its impact on the neighbourhood lingers for a long time. The large volumes of gases and ash emitted can influence climatic pattern for years.

The earth's tilt

Not easy to understand for the common man! The earth rotates on its axis which is presumed to be fixed. But the reality is different. Actually, the axis does move at the rate of about half a degree every century! This gradual change in the direction of the earth's axis (known as precession) is responsible for changes in the climate.

Continental drift

The continental drift of landmass has resulted in the formation of different continents, islands and thereby different countries. This drift changes the physical features of the land mass as also the water bodies. The movement of landmass can affect the flow of winds and ocean currents which in turn affects climate. It has been reported that because of the movement of Indian land mass, the Himalayan range is rising by 1 millimetre every year.

Ocean currents

As everyone knows, around 70% of the earth's surface is covered with water. Hence oceans are a major component of the climate system. The changing patterns of ocean current can greatly impact the climate of a region. The study of ocean currents has led to the concepts like El Nino effect which has its origin in the Pacific Ocean but is believed to affect climatic conditions all over the world.

Anthropogenic causes:

Unlike the natural causes these are considered more critical for two reasons – one ,for its impact and secondly though classified as controllable , given the vast spread of humanity ,these are quite uncontrollable as on date! A deep study indicates a few major factors as major causes threatening the environmental balance.

Increasing consumerism

The modern concept of marketing thrives on consumerism! One big development was the concept of 'use and throw', which we in India, had also borrowed from the West. This, in fact is considered to be the single largest reason for all the environmental issues which in turn impact climate change. Today, yes, it is a big 'NO' to disposable plastic goods but too late, since the damage has already been done.

Pollution

The high levels of pollution in air, water as well as land are all indirectly contributing to climate change. Ozone-depleting substances, including chlorofluorocarbons (CFCs), are known to heat the atmosphere more severely than carbon dioxide. CFCs which were developed in the 1920s and were widely used in aerosol sprays, refrigerators, air-conditioners etc. This caused extreme damage to earth's ozone layer leading to global warming. Thankfully, the greenhouse gases CFCs have been banned since 1996.

Indiscriminate use of technology

It is indeed true that technology is a double-edged sword. Advancements in technology have thrown up numerous products to replace the old 'products for a life time'. Electrical and electronic gadgets are the norm today. Indiscriminate use, irrespective of whether a product is needed or not, is the fashion. And for the most part, these are not eco-friendly which causes problems of disposal. The mobile phones and its associated support system are the latest and biggest threat-both the physical product and the radiation caused by them.

Greenhouse Gases

Undoubtedly carbon dioxide is the most important greenhouse gas in the atmosphere. Greenhouse effect is referred to the process by which radiation from a planet's atmosphere warms the surface of the earth to levels above the normal temperature. Though this problem started with industrial revolution, alarm bells have started ringing only about two decades back. The daily activities of an individual like using the electric kettle or driving a car or watching TV all contribute to greenhouse gases and thus climate change. Research findings indicate fossil fuels are responsible for the emission of huge amounts of greenhouse gases and other pollutants. Situation is such

that today even agriculture makes its contribution to greenhouse gases!

Policies of Governments

In spite of evidence at hand, climate change remains one of the toughest and most intractable issues threatening mankind. In the US, Republicans and Democrats are deeply divided on the priority to be given to climate change.

The front-page headline of 'The Hindu' dated 16/12/2019: 'No deal as the longest climate talks end.' The 12 days international climate talks involving almost 200 countries at Madrid were extended by another two days, but still was not fruitful. It resulted in just a declaration made to help poor countries that are suffering the effects of climate change, but no new funds were allocated to do so.

Trans disciplinary learning to tackle climate change:

Solution to this long-standing problem of climate change may lie in creating a system which works effectively for a region or state or country. Several measures are in force and several more are being put forward every day. Ironically today when it comes to climate change everybody wants change the world but nobody wants to change oneself!

Perhaps education sector could lead the way in halting the damage. Formulating a new discipline relating to climate change will go a long way in making the younger and future generations conscious of maintaining a healthy climatic environment. Tran disciplinary approach is an integrated model where the relevant aspects pertaining to the issue in hand have to be integrated to create a whole new field directed at addressing the specific issue. This means new learning and new experience as it involves spanning out across disciplines.

This will give rise to different ways of exploration to provide a layered understanding of climate change or any other problem of study. Instead of compartmentalizing the learning this will allow merger of content with context. This calls for a shift from the individual comfort zones to unexplored areas. The underlying problem with the present measures is that each may be effective in their respective areas but a gap exists between the different measures. For example: While agriculture scientists have a solution, this may be in conflict with the decisions taken by political experts. Hence what is needed is a system which weaves a web of interrelations between the various factors influencing climate change both controllable and uncontrollable, more specifically in the particular region being considered. To a large extent, this problem could be overcome by adopting transdisciplinary learning. Ideally this must be accessible and practiced by one and all irrespective of whether they are presently affected by climate change or not. Prevention is always better than cure.

How does transdisciplinary learning work?

It is basically sharing of knowledge for a common purpose. It integrates the perspectives of multiple disciplines in relation to the issue in hand. It helps to delve deep and understand the issue or problem much better.

Tran disciplinary learning for climate change is interestingly an untapped chapter which could easily prevail over the gaps existing in other efforts in stalling climate change. This necessitates a look at the various disciplines having a direct or indirect impact on climate change. We as a society will have to reflect on the deeper specifics of climate change, many of which may still be unknown or hidden from the common platform.

Tran disciplinary learning encompasses universal understanding of climate change to all irrespective of their geographic location, culture, language or beliefs. This concept may ensure a transition from 'their responsibility' to 'my responsibility' with each one being responsible to sustain Mother Earth and each one contributing their little for this common cause.

'Planet Conservation' or 'Addressing

Climate Change' or some other suitable terminology must be adopted for the new discipline. The highlight must be that this is incorporated in all academic streams - same subject with same syllabus across all disciplines, be it engineering, pure sciences, arts or social sciences. This must necessarily include contributions from each discipline, all being shared and blended together to create an effective response system. Is this asking too much given the criticality of the problem?

Unlike the earlier environmental issues which were more area specific and it was rather easy to provide solutions by studying the cause and effect. But today that is not the case. The cause may lie in one part of the planet while the effects may occur in some other part of the globe! Hence it is not easy to find the relationship between factors. Intra-disciplinary learning must be a collaborative effort of all stakeholders with high levels of engagement. It ought to transcend the confines of each discipline taking steps to help connect with the real world.

Now to analyse what disciplines have to be considered for this new concept of trans – disciplinary exercise. Given the varying nature of climate in different parts of the world, further research is essential to prepare a complete list of disciplines that need to be considered for developing title and syllabus of new subject. Nonetheless, from current study it can be inferred that those mentioned below are important.

As studies have indicated the geographic conditions of a region has a direct impact on the climate of the region. Some countries or regions of a country may be more vulnerable to climatic changes. The proximity of a country to the Ecuator or the Arctic will have its own effects. For example, according to National Geographic, Bangladesh is one of the most vulnerable nations to the impacts of climate change. By understanding geography and people's relationship to location it is possible to suggest better solutions.

What has history got to do with planning for the future? Before deciding on any steps to manage climate change in any place, it becomes important to analyze the history of that place. This will give an understanding of the pattern of climate change over a period of time as also migration of people from regions.

If not for the media, the world would not know what is happening in different corners of the world. In relation to climate change, journalism acts as the trigger for action. For example, Columbia Journalism Review reported that AbuDhabi is planning to have the first city (Masdar city for fifty thousand people) in the world with zero carbon emission- a city which relies entirely on solar power and other renewable energy!

Action on climate change is arguably the biggest challenge today. At the recently concluded (December 2019) climate talks in Madrid UN Secretary General Antonio Guterres had warned that failure to do so could result in economic disaster. Clearly the economic models till now have not been effective in controlling climate change.

Climate change, especially global warming can adversely affect agriculture production be it the yield or quality of produce. The drastic change in seasons be it the untimely rains or advanced summer, all of it can have a catastrophic impact on agriculture.

Technology is a double-edged sword. It has been a major cause for climate change, a recent and highly serious one being the advent of mobile phones. But technology only can find solutions to the various climatic issues through new inventions that could help in meeting climate change.

The role of management in mitigating climate change cannot be undermined. Any result cannot happen overnight. It has to be done in phases and this process requires great planning. Effective strategies have to be formed for adaptation or mitigation.

Politics was the main reason for the stalemate in the recently concluded climate centric talks at Madrid in December 2019. .The lack of trust in the Governments could be one barrier for effective environmental action.

Given the severity of climate crisis and its potential to wipe out the human race, lack of intensity around this issue is incomprehensible and unacceptable. It is high time the head of states came out with a realistic solution.

It is high time a new subject or discipline was initiated to study the topic more precisely so as to come up with more effective practical steps to meet the challenge called climate change. Starting with history, moving with geography, touching upon journalism and other art disciplines, forestry, religion, geology, pure sciences and social sciences including management and yes, not to forget research and last, but not the least politics! This will help look at the issue of climate change from a total perspective which can help to shut out the gaps formed in efforts taken by the different disciplines individually in facing climate change. It should be refined in such a way that climate maintenance becomes the responsibility of each individual, however small his/her role maybe.

A case study on 'The Nilgiris' in India:

India is not exempted from climate change. The frequency of heat waves and power are increasing in India because of climate change. In 2019, in some places in north India, the temperature reached 50.6 degrees Celsius, which sadly even led to the death of several people. The author has conducted a case study on Nilgiris district in TamilNadu.

Nilgiris in TamilNadu is one of the most fragile eco-systems not just in India but the entire world. It is facing widely fluctuating temperatures and erratic rainfall. The pattern and intensity of rainfall has changed dramatically. Now climate change in the form of unpredictable rainfall is also taking a toll on the region's indigenous people, plants and animals.

Ooty or Ootacamund in the Nilgiris is one of the most prominent tourist spots in South India and is a favourite shooting destination for several film makers! It is home to several rare plants and herbs. Nilgiris Biosphere Reserve is a UNESCO World Heritage Site.

According to Krishnaswamy, an eco-hydrologist by training, who has been observing and analyzing Nilgiris region since 2012, "The challenging part is none of the climate models have been able to capture the decline in the Indian monsoons. Also, in the Nilgiris specifically, there have been shifts in how the southwest monsoons and northeast monsoons behave." According to reports of the India Meteorological Department, since 2012, the annual rainfall recorded in the Nilgiris has varied dramatically, while consistently falling below the expected annual rainfall of 1,920 mm. Also, rather than the rains being spread out over nine months of the year, it is intense at certain times and non-existent at others with no discernible pattern! The lack of predictability in rainfall has also interfered with traditional agricultural practices of the indigenous people of the Nilgiris. As per a report in 'The Hindu' dated 17/12/2019, 'in what could be a sign of the impact of climate change in the Nilgiris, analysis of rainfall patterns stretching back more than six decades has revealed that 2019 was one of the wettest years on record, but strangely, had a few number of 'rainy days' when compared with the average. The scientists at the Udhagamandalam station of the ICAR-IISWC confess that they are unable to pin down a direct correlation between climate change and rainfall patterns in the district, but feel that global warming could definitely be one of the main factors driving the changing rainfall patterns. Principal scientist and Head of this centre Mr.Kannan had pointed out that" the rainfall pattern analysis in the Nilgiris showed that strategies to mitigate the effect of climate change needed to be implemented to better cope with the changing climate".

The National Science Day commemoration in 2019 began with the inauguration of two-day national seminar on climate change and its impact on human health and wildlife in the Nilgiris. According to the Nilgiris District Collector Innocent Divya , the top bureaucrat in the district, "The drought in 2016-17 was so severe that even underground aquifers began drying up. And for the first time,

because of lack of drinking water, the then collector had to order digging of borewells for water supply." As a person well acquainted with the region she had further said "I see this as a critical sign of change in the ecosystem. We have to wake up and act immediately." "We are remapping the water resources in the entire district and are in the process of drawing up a plan to protect them under various central and state government schemes". "We are also aiming at rejuvenating water systems such as the Segur river, which can prove as a vital lifeline for elephants and other wildlife in our district."

Anita Verghese of The Keystone Foundation had once said, "I have been told that the flowering patterns of many plants and trees in the region have changed. In her opinion, "What I see is that people who live in close connection with nature, agriculturists, fisher folks, hunter-gatherers, they are all saying they can't predict the weather any more. There is something changing here and it is quite apparent that this is anthropogenic climate change." Verghese and the Keystone Foundation have been working with the indigenous people of the region, including the Kurumbar and Irular tribes, for over two decades.

'The Hindu', January 30, 2020 has this heading Mass death of eucalyptus trees raises concerns in the Nilgiris" which is just one report on climate change there. It is another grave finding in the Nilgiris linked to climate change. Godwin Vasanth Bosco,a restoration ecologist working in the Nilgiris, had this to say " I believe these deaths are the first manifestations of climate change and excess carbon emissions, which has weakened the trees and have made them more susceptible to disease or becoming negatively affected by extreme weather." Rather than hinging on stop gap arrangements, as is the usual practice as solution for any problem, the local people in this district trust nature to take care of itself in the form of slow adaptation .

All hope is not lost thanks to the timely initiatives being taken by the Government, NGOs and other benefactor institutions. It is heartening to see optimism in their efforts. There is a collective sense of responsibility combined with steps to restore the balance in nature. Here the author would like to quote the article 'Think Climate change action, act glocal' by Sujatha Byravan (a scientist who studies technology, science and development policy) in 'The Hindu' dated 23/1/2020. She had this to say "In fact the growing global stalemate gives India the chance to focus on the State and sub-State levels. Attention to climate change offers co-benefits to India for development."

Yes, India has the potential provided the political will is there. Trans-disciplinary learning integrated as a new subject or discipline made common to all fields of study possibly might help in resisting climate change and help in restoring the old charm to Nilgiris.

Conclusion:

Addressing the issues related to climate change is the need of the hour. Indeed a lot has been talked about this at different international forums. But still a lot needs to done in this direction. What is required is a collaborative effort by all stakeholders where the central issue and all the major elements associated with it merge. What makes the issue more challenging is that not all possible causes of climate change are yet fully understood!

On a global level, India could take the initiative and lead the way out of the current stalemate in the discussions on climate change. This is possible only with a shared vision by all stakeholders in the major countries. It calls for greater transparency and involves setting up a global pool of resources.

On a final note-let we not scare ourselves with this bizarre issue of climate change. Yes, it is real and very serious. Even a small disruption in nature's cycle will have a big impact on all living organisms on the earth. It is indeed true that nature has the power to develop its own corrective mechanism and heal itself. But this will take a very long time and also it is possible only if human

intervention is nil or kept to the minimum. It is important to be eco-friendly at all times. A word of caution especially in the current fast paced times- Rampant, unscrupulous and unreasonable use of advancements in technology may prove to be a bane more than a boon!

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ROLE OF EDUCATION IN PRIMARY YEARS PROGRAMME TO COMBAT CLIMATE CHANGE

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Introduction

Education plays a vital role in fighting against climate change. Many schools have started integrating the current scenarios of education with changing climate and its reasons. Some schools have begun taking positive steps so the plans can be executed properly. The rapid growth of population, consumerism and technology - ways of living have given rise to the problem of climate change. We need education to educate the future generation to understand the aspects of climate change. Education is important to deliver the conceptual understanding about the same. Many International Baccalaureate (IB) schools have started taking actions against it and some of them are even successful.

Kids often hear about climate change in the news, but the fact is they don't know the phenomenon behind it. As mentioned on studyinternational.com news on climate change that we frequently talk about floods, droughts, super storms, avalanche, ominous weather patterns but we forget to ask what could be the suitable action to fight against it. How can we be resilient to gain that fear and fight against it. Young learners need academic reasoning and structure in order to contextualise climate change and have an outlook to ask questions that could help them to erase their fear. Teaching kids about climate change not only spur them to take action but it will also help them to share the same information with others and prepare them for their future because these kids will be the future of this world and will be responsible for developing climate change solutions. We are trying our maximum to integrate science, technology, engineering and math (STEM) activities and skills into our kids using maker space sessions.

While it will take some time to integrate climate change education in schools, there are some transdisciplinary themes that are frequently brought up when discussing how to teach this topic effectively.

In this article, we define the special aspects of climate change and how sustainable goals of the United Nations are taken into consideration for educating the future generation using IB curriculum.

What is climate change: Climate change is a serious weather condition when the climate gets warmer, wetter, or drier. It happens in a long-time frame that differentiates the climate than the natural weather consistency. And while "climate change" and "global warming" are two words of the same coin and often used together, global-warming is the sudden change in the climatic conditions.

Climate change can be measured over a due course of time. Earth-orbiting satellites, remote meteorological stations, and ocean buoys are used to track current weather and climate changes. Scientists use data which is called, paleoclimatology from natural sources like tree rings, corals to record earth's climatic record in past so many years. These records will give an inclusive vision to observe long-term changes in earth's atmosphere, oceans, and land surface. Further, this data can also be used to predict future climate trends.

Education and climate change: Education plays a very important role in studying climate change globally. It helps young minds to understand the impact of global warming and its consequences, and to change their attitude further transformation their behaviour towards use of excess resources

which directly or indirectly harming the environment. Consumerism, it means a socio-economic order that encourages a consumer to acquire goods and services in increasing amounts, is one of the major factors of climate change and today's generation needs to know the after effects of consumerism, which can be done by educating them.

Reasons for climate change: Scientists share that our Earth is at risk of calamitous effects from global warming. They are majorly concerned that natural variations in the climate are being overtaken by a rapid human ingenuity that has serious implications for the stability of the climate. Growing emissions of carbon dioxide from human activities are driving up temperatures. Subsequently, it is increasing weather, melting polar ice and accelerating global sea level rise.

Several factors, both natural and human, can influence the earth's climate system.
Here are a few major reasons for climate change:

A) Sea level rise: Rising of sea level is linked to three factors:

1. Thermal expansion: Water is heating up and it expands. About half of the sea-level rise in the past 25 years and its occupying more space.
2. Melting glaciers: Glaciers are melting a bit each summer. Because of higher temperatures caused by global warming have led to greater than average summer melting as well as decreased the level of snowfall in winters. That has created a lot of imbalance, causing sea level to rise.
3. Loss of Greenland and Antarctic ice sheets: Due to high temperature, massive ice sheets are covering Greenland and Antarctica is melting more quickly.

All of these things are happening because of the change in temperature and adding more gases to the greenhouse.

B) Beef has the biggest carbon footprint: A study showed that a massive variation in the environmental impact due to producing a similar type of food. For example, beef cattle raised on devastated land produces which releases greenhouse gas emissions more than 12 times than those reared on natural pastures.

The analysis shows that although the meat has lowest environmental impact but still it creates more greenhouse gas emissions than growing vegetables and crops.

C) Greenhouse gasses: Scientists believe that we are adding more greenhouse gasses to the natural by emitting gasses from the industry and agriculture and trapping more energy which leads to increase in temperature. This refers to global warming. China and the United States of America (US) are the world's top most gas emitters.

Threat for Urban areas: Almost 95% of the population are facing threats and risks because of global warming in Asia and Africa. We found a report by risk analysts Verisk Maplecroft. "Maplecroft is a global risk and strategic consulting firm based in Bath, UK. Its work includes analyzing key political, economic, social and environmental risks affecting global business and investors." This company was founded in 2001. And its parent organization is Verisk Analytics, Ltd.

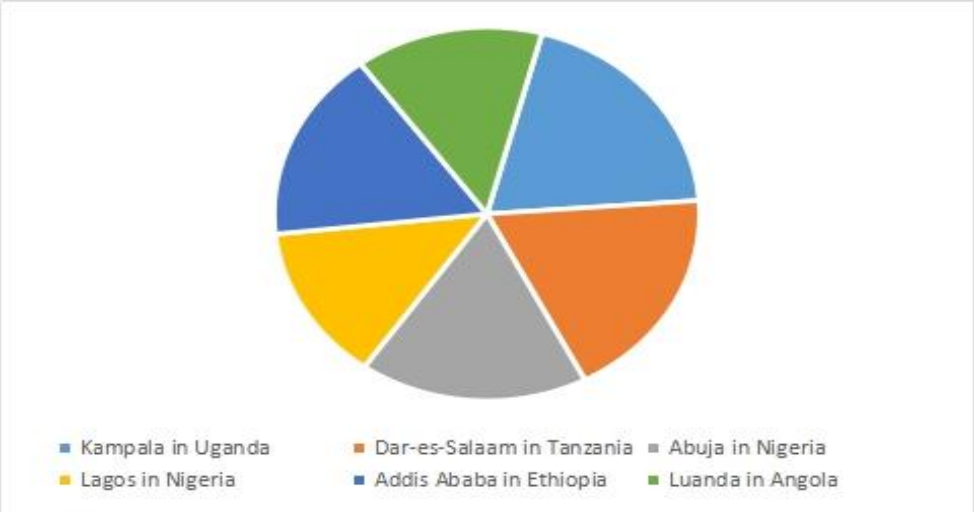
Most affected cities by climate change in Asia & Africa:

Urban centres in Africa dominate in terms of population growth. They are rated "extreme risk" in the climate change vulnerability index (CCVI) which includes 15 Afircan capitals and many of the continent's key commercial hubs. Kampala in Uganda, Dar-es-Salaam in Tanzania, Abuja & Lagos in Nigeria, Addis Ababa in Ethiopia and Luanda in Angola are the most at risk of climate change.

Table 1 Cities affected by climate change in Asia & Africa

Cities in Africa and Asia	Population growth annually
Kampala in Uganda	5.1%
Dar-es-Salaam in Tanzania	4.8%
Abuja in Nigeria	4.5%
Lagos in Nigeria	3.5%
Addis Ababa in Ethiopia	4.3%
Luanda in Angola	3.7%

Image 1 Graphical presentation - Affected cities in Asia and Africa



Source:https://www.maplecroft.com/insights/analysis/84-of-worlds-fastest-growing-cities-face-extreme-climate-change-risks/

According to the Climate Change Vulnerability Index (CCVI) it is found that the fastest growing cities are at extreme risk because of their rising rate of population. Europe is still in the safe zone because this continent is rich compared to Asia and Africa and can bear the loss. The relationship between climate change vulnerability and rates of population growth is strong. Where above, in mentioned pie-chart that lack adequate healthcare facilities and due to this population is getting more vulnerable to getting diseases.

World Health Organization (WHO) reports, "climate change is expected to cause approximately 250,000 additional deaths per year" between 2030 and 2050. People are getting illness with increase in temperature. Heat stress, heatstroke, and cardiovascular, lungs and kidney disease are some of the common illness which is found in people around the globe. As air pollution worsens, so does respiratory health. According to current record approximately 300 million people living with asthma worldwide. Different types of allergy diseases and fever are detected because of airborne pollen present in the air. Extreme weather conditions, such as severe storms, avalanche,

droughts and flooding, can lead to injury, drinking water contamination, draughts can give dehydration and storm damage that may cause harm to the basic infrastructure. It is expected that a good number of people will migrate from one part of the world to another to survive and it will cause more threat to an environment like increases in urban crowding, trauma, social unrest, lack of clean water and transmission of infectious diseases. A warmer, wetter world is also a boon for insect-borne diseases such as dengue fever, West Nile virus, Lyme disease and coronavirus (which is recently detected in China in January, 2020 and getting spread all over the world by the people who are migrating from China to other parts of the world. As per the information by bbcnews.com, nearly 42000 people are infected and 1000 people died with this, 11th February, 2020.)

Objective: The objective of the present study is to-

1. Analyze the rapid change in the climatic conditions.
2. Identify factors or reasons which lead to climate change.
3. Analyze the impact of climate change in Asia / African countries.
4. Provide recommendations to the schools to integrate sustainable development goals for education to educate the young learners.

Special aspects of climate change and sustainable goals of the United Nations are taken into consideration for educating the future generation using IB curriculum.

Review of literature:

A considerable amount of literature has been published on the drastic change in climate and its effects. Many research papers have been reviewed before suggesting a new curriculum which is integrated sustainable development goals for education, which can easily be applicable at elementary level of education.

Yonah & Uhlmann (2009) - "The urgency of climate change crisis calls for immediate action, which can be provided best by a carbon tax imposed on all coal, natural gas, and oil produced in the country and imported from other countries."

Further, it is also mentioned, that "The global climate change crisis will not be resolved simply by implementing a carbon tax or a cap and trade system—or by any other legislative approach. Fundamental changes in energy production, development, and conservation, as well as changes in transportation, land use, and natural resource policies, must be pursued alongside efforts to reduce carbon dioxide emissions."

Bodansky (2010) shares in his symposium that "Rights council has adopted several resolutions on climate change and requested the authority to produce a report on the subject, which was published in 2009. Additionally, the academic community has examined the theoretical and practical issues involved."

Further, "Human rights law recognizes not only substantive rights such as the rights to life and to food, but also procedural rights such as the right to information and the right to participate in government decision-making process."

Chitre (2011) has mentioned that "any country's ability to implement environmental policy on climate change at the national level is critical to its ability to participate in negotiating climate change law and policy at the international level."
Further, it is said - "India can build a grassroots movement involving bottom-up advocacy and education to utilize better implementation of environmental laws."

Kahan, Peters, and Braman (2011) mentioned in their research paper that "Public do not know what scientists know, or think the way scientists think, they predictably fail to take climate change as seriously as perfectly rational risk-evaluators would." Further, it is also concluded that "the average person

underestimates the seriousness of climate change because he/she is not sufficiently knowledgeable about science."

Kahan (2013), identified his in research paper that "Modern science has confessed on us the knowledge necessary to live healthier, safer, and more prosperous lives that our forebears could even have imagined, much less lived."

Ostrom (2016), has suggested "the polycentric approach which encourages experimental efforts at multiple levels, leading to the development of methods for assessing the benefits and costs of particular strategies adopted in one type of ecosystem and compared to results obtained in other ecosystems. He thinks it's a useful approach to take with respect to global change."

Ostrom further mentioned that "Rosina Bierbaum, Dean of the school of Natural Resources and environment at the University of Michigan, in her own excellent analysis of the problem, stressed the imminent dangers that the world is facing due to melting glaciers, rising sea-levels, reduced food supplies, as well as expected increases in extreme events that climate change was stimulating."

Bodansky and Rajamani (2012), has mentioned in his chapter that "theory of greenhouse warming has been understood by scientists since the end of the nineteenth century, an international legal regime" to address the problem of climate change began to develop only in the late 1980s.

Further it was also mentioned that "The intergovernmental panel on climate change was established in 1988 by the world Meteorological organization (WMO) and the United Nations Environment Programme (UNEP) to provide decision-makers and others interested in climate change with an objective source of information about climate change."

Bodansky (2011), in another research paper has mentioned that "the Kyoto Protocol's entry into force in 2005. But only few countries - representing only about a quarter of global carbon dioxide emissions and have been willing to accept internationally-defined emissions reduction targets under Kyoto Protocol. Some countries like Japan, Russia & Canada showed the unwillingness to continue this path and other emitters like USA, China & India - has never accepted the Kyoto Path."

Kyoto Protocol is set at international level among industrialized nations to set minimum or maximum limit for emitting greenhouse gasses.

Sunstein, Sharez, Lazzaro & Sharot (2016), It was demonstrated from their survey results that "exposure to varied scientific evidence about climate change may increase polarization within a population due to asymmetrical updating."

Additionally, it is also mentioned that "within the US the Environmental Protection Agency States, "Increase in average global temperatures are expected to be within the range of 0.5° F to 8.6 ° F by 2100, with a likely increase of at least 2.7° F for all scenarios except the one representing the most aggressive mitigation of greenhouse gas emissions."

Maddison, 2016 stated in his paper that "according to the survey results it is revealed that significant numbers of farmers in Africa believe that temperatures have already increased and that precipitation has declined." "The farmers with the greatest experience are most likely to observe climate change."

According to Maddison, "in six out of the ten countries the majority of farmers believed rainfall levels had decreased." And "a considerable minority also believed that they had witnessed a change in the timing of the rains."

Bigano, Goria, Hamilton & Tol (2005) mentioned that "climate change affects the tourism industry and holds a lot of tourists to

travel to particular destinations, and the consequences for the same would be - it highly impacts on our country's economy.

It is also concluded - "Tourists might be deterred not only by unbearable weather conditions, but also because the nice sandy beaches that used to be the pride of a resort are not there anymore due to sea-level rise and coastal erosion, or because the unique eco-system of a destination has been compromised, or because, by travelling in that area, catching some tropical disease has become more likely."

Activists those who are fighting against climate change -

Greta Thunberg, an activist, who is known to everyone for her activism in August, 2018. When she was just 15, she began spending her school Fridays outside the Swedish parliament to spread awareness among people and the government to take stronger action on global warming. Her hoarding says "School strike for the climate". Soon after this, other students also got engaged in similar protests in their own communities. They come up with a school strike movement under the name "Fridays for Future". Greta has adopted different lifestyle choices to reduce her and her family's carbon footprint, including giving up air travel and not eating meat.

Many organisations like UNESCO have taken big actions to implement their plans to save the world. A curriculum can be designed to implement the change in education that can be central and visible part of the International Baccalaureate programme. One of their publications talks about "Change the minds, not the climate - The role of education". Many youth activists have come to join the campaign run by UNESCO on climate change. "Youth Leadership Camp for Climate Change". This programme was designed to provide knowledge about climate change in agriculture and energy, marine and fisheries and forestry sectors. At the end of the camp, three youths were selected to participate in the Tribal Climate Camp in Washington DC, United States of America (USA) to build their capacity to address climate change and associated economic, social, cultural, regulatory, and technological trends and impacts within and between communities.

In 2019, the United Nations (UN) held the first-ever, United Nations (UN) Youth Climate Summit. This platform was designed for the young climate action leaders to showcase their solutions at the United Nations and to meaningfully involve decision-makers on the defining issue.

There are many young activists who are working to raise our voice against climate change and making society aware.

Autumn Peltier, a 15 years old belongs to the Wikwemikong island in North Ontario, Canada. She is fighting for providing clean water to her society. She started her activism when she was eight years old. She has spoken in many public events. In 2016, she raised the same request to the Canadian Prime Minister Justin Trudeau at the Assembly of First Nations' annual meeting. Her name was proposed for the Children's International Peace Prize.

Leah Namugerwa, she is 15 years old and heading this change movement in Uganda. She was the first person in Kampala who planted 200 trees on her 15th birthday. Inspite of getting lot of criticism she has made a group to support her. Leah is trying her best to convince Kampala's government to ban plastic bags and make others understand the harmful effects of deforestation, draughts, and floods. Leah has formed a petition against climate change. She is actively running a page on twitter #BanPlasticUG. Like Autumn, Leah has also given a speech to the public at the United Nations Habitat Assembly, mentioning how can we change our living style by keeping things simple with the help of technology. She is a follower of Fridays for Future, which is led by Greta Thunberg.

Ridhima Pandey, an 11 years old activist, her interest turned into an activity when she experienced Uttarakhand floods, in 2013 which affected the lives of millions of people. According to the report almost 5,000 people lost their lives and more than 4,000 villages were damaged. When she was 9 years old, in 2017, Ridhima has also raised her concern to to the Indian government for not taking any action towards climate action. She suggested the Indian government to come up with a budget to support climatic conditions of the country and check carbon emissions produced in the state or the country.

Xiye Bastida, Xiye was born in Mexico and brought up close to nature. In her town, San Pedro Tultepec, she has experienced radical effects and climate change with drought and fluctuating heavy rainfall in her town. Because of this she has decided to become an activists and spread awareness among people about climate change effects. In 2015, she made a club for activists named, environmental club, at her school. Simultaneously, she joined many other groups on social sites and become a member of these groups who were fighting against climate change. Later, she joined Fridays for Future strikes in New York city.

Isra Hirsi, a 16 years old activist, she has been fighting for environmental justice when she was around 14 years old. Being a young black Muslim woman in the United States, she made a group of her community who is convinced with her. She wanted to aware society that how climate change affects more to black people because of lack of resources. Because they don't get basic services like others that can help them to protect them from the extreme weather conditions.

Research methodology: We have used a qualitative approach to fulfil our objectives. We are trying to suggest a new curriculum for the International Baccalaureate Primary years programme which will help teachers to integrate learning objectives with sustainable development goals which are established for education by the United Nations. We are using different themes which come under international baccalaureate primary years programme and suggesting few topics which can be easily covered to combat climate change.

IB curriculum: The International Baccalaureate (**IB**) offers international education of high quality three different programs to a worldwide community of schools. These three programs for students aged 3 to 19. These programmes help to develop student's intellectual, personal, emotional and social skills to live, learn, play and work in a rapidly globalizing world. This curriculum aims to do more than other curriculum by developing approaches to learning skills (Self-management, research, communication, thinking, and social). This programme encourages students of all ages to think critically and challenge assumptions. It develops independently of government and national systems, incorporating quality practice from research and our global community of schools. It helps us to encourage students of all ages to consider both local and global contexts and develops multilingual students.

According to the International Baccalaureate Organisation (IBO), "this programme provides a continuum of education and consists of four programmes that are united by the International Baccalaureates' philosophy and approaches to learning and teaching. This programme encourages both personal and academic development, and challenges students to excel in their studies."

IBO provides three programmes –

In the Primary Years Programme (PYP) aged ranked 3-12 years, it has six transdisciplinary themes: Who We Are, Where We Are in Place and Time, How the World Works, How We Express Ourselves, How We Organize Ourselves, Sharing the Planet.

In the Middle Year Programme (MYP) aged ranked 11-16 years, it is encompassed of eight different subject areas. Language acquisition, Language and literature,

Individuals and societies, Sciences, Mathematics, Arts, Physical and health education, and Design.

In Diploma Programme (DP) aged ranked 16-19 years, it is a complete assessed programme and it is respected by leading universities across the globe. It offers excellent in depth knowledge of the subject in the student's chosen subject area. It flourishes physically, intellectually, emotionally and ethically. Students have to study at least two languages. He / She has to excel in traditional academic subjects, and explore the nature of knowledge through the programme's unique theory of knowledge course.

In Career related Programme (CP) aged ranked 16-19 years, it is a unique programme to address the needs of the students related to their career. This programme leads to further higher education, apprenticeships and employment.

In this paper, we will be focusing primarily on the Primary Year Programme (PYP) and its curriculum integration with climate change to foster new beginnings for young learners. In Primary Year Programme the whole curriculum is outlined by programme of inquiry (POI) which is presented grade wise (1-5) for years 6-11. The other subjects like mathematics, english, physical education, music, library, arts are all integrated with the current theme and integrate all the learning in a broader way.

Link between IB curriculum and climate change: These six IB PYP themes provide IB World Schools the opportunity to incorporate local, political, social and global issues into the curriculum and effectively allow students to "step up" beyond the limits of learning within subject areas. In the newly proposed logo of PYP Next also suggests about the Voice (of kids), Choice (to present their task in either way and can be assessed) and Ownership (responsible for their own learning) under the guidance of the teacher or a mentor.

As mentioned in education for sustainable goals - learning objectives pdf -
"Education for Sustainable Development" – a key instrument to achieve the SDGs
"A fundamental change is needed in the way we think about education's role in global development, because it has a catalytic impact on the well-being of individuals and the future of our planet … Now, more than ever, education has a responsibility to be in gear with 21st century challenges and aspirations, and foster the right types of values and skills that will lead to sustainable and inclusive growth, and peaceful living together." - Irina Bokova, Director-General of UNESCO

"Education can, and must, contribute to a new vision of sustainable global development. (UNESCO, 2015)

Education for sustainable development aims to develop the willpower of the individuals to reflect on their own actions, considering all the key factors - social, cultural, economic, political and environmental impacts, from a local and a global perspective.

"The United Nations Decade of Education for Sustainable Development (2005–2014) (DESD) aimed at integrating the principles and practices of sustainable development into all aspects of education and learning. It also aimed to encourage changes in knowledge, values and attitudes with the vision of enabling a more sustainable and a just society for all".

Climate change is a global issue which comes under a list of sustainable goals.

<u>Proposed curriculum for IB PYP schools for improving the situation:</u>

A sample of the Programme of Inquiry which is used generally in the Primary Year Programme.

Table 2 Sample of Programme of Inquiry in IB PYP schools

Grade	Theme	Central Idea
Grade 1	How the world works	Identifying and using cycles and patterns helps us to make sense of the world.
Grade 2	How We Organize Ourselves	Communities develop systems to meet their needs.
Grade 3	Who We Are	Children have rights and responsibilities that enable them to participate in community life.
Grade 4	Sharing the Planet	People can make choices to support the sustainability of earth's resources.
Grade 5	How the World Works	Design depends on environmental factors and human ingenuity.

Source: Full Programme of Inquiry for grade 1-5 is available at https://drive.google.com/file/d/18nPAX71esTS_XNtRHV7kG4l2D7Syx1UK/view?usp=sharing

Every theme in itself is special and students can learn about these global issues in the context of programme of inquiry, each of which addresses a central idea. Lines of inquiry addresses the scope for learning with the main idea with the help of related concepts of the unit of inquiry.

Table 3 Sample of Programme of Inquiry integrated with sustainable development goals for education with the same curriculum, in IB PYP schools

Grade	Theme	Central Idea	Sustainable development goal (SDG)
Grade 1	How the world works	Identifying and using cycles and patterns helps us to make sense of the world.	SDG number 13: "Climate action" [Action to combat with climate change and its impacts]
Grade 2	How We Organize Ourselves	Communities develop systems to meet their needs.	SDG number 6: "Clean water and Sanitation" [Availability of clean water and sanitation for all]
Grade 3	Who We Are	Children have rights and responsibilities that enable them to participate in community life.	SDG number 5: "Gender equality" [Empowerment for women and girls]
Grade 4	Sharing the Planet	People can make choices to support the sustainability of earth's resources.	SDG number 11: "Sustainable cities and communities" [Make cities inclusive, safe, resilient and sustainable]
Grade 5	How the World Works	Design depends on environmental factors and human ingenuity.	SDG number 9: "Industry, Innovation and Infrastructure" [Infrastructure which promotes inclusiveness and sustainable industrialization, and new technology]

Source: Sustainable development goals for education is available at: https://www.luminpdf.com/viewer/5e48366a5bc53100118b197b Full Programme of Inquiry

integrated with SDGs, for grade 1-5 is available at https://docs.google.com/spreadsheets/d/1KWo9ekw9MoO9cfFdRalDYULukVYjKqBy/edit#gid=1279321006

In this paper, we have tried integrating most of the sustainable goals from the above shared document with the Programme of Inquiry because International Baccalaureate is the only curriculum which is very much flexible for teaching and learning and can incorporate current issues and problems easily. If most of the goals will be absorbed by most of the themes then we could say we are progressing in the direction where education is combat with climate change. As we said earlier, climate can not be changed but action needs to be changed.

To understand the new proposed curriculum for the Primary Year Programme you need to review the above shared document simultaneously.

For grade 1 (year 6-7), under the theme **"How the World Works' '** - the unit is "Cycles and Patterns" which majorly talks about identifying and using cycles and patterns helps us to make sense of the world. For this I have suggested the sustainable development goal number - 13 **"Climate change"** - Take urgent action to combat climate change and its impacts. The topics which can be easily covered with this age group - a) Sea-level rise and its consequences for countries. b) Effects of and impacts on big eco-systems like forests, oceans, glaciers and biodiversity. The related concepts could be - climate, seasons, systems, orbit, lunar cycle, water cycle.

Another important theme for the similar grade would be - "**How We Organize Ourselves"** - unit name is - "Process and changes" which talks about items go through a process of change before they are used. For this I have suggested the sustainable development goal number - 7 **"Affordable and clean energy"** - Ensure access to affordable, reliable, sustainable and clean energy for all. The topics which can be easily covered under this unit would be - a) Energy production and usage of different countries. b) Efficiency and sufficiency in energy usage. c) Environmental impacts of energy production.

For grade 2 (year 7-8), under the theme "**How the World Works"** - unit name is "Innovation" which talks about how innovative thinking can lead to change. For this I have suggested the sustainable development goal number - 4 "Quality Education" - Ensure inclusive and quality education and promote lifelong learning opportunities for all. The topics which can be easily covered under this unit would be - a) Education as a public good and a fundamental human right. b) Diversity and inclusive education.

Another important theme for the similar grade would be - "**How We Organize Ourselves"** - unit name is - "Systems" which talks about how communities develop systems to meet their needs. For this I have suggested the sustainable development goal number - 6 "Clean Water and Sanitation" - Ensure availability of clean water and sanitation for all. The topics which can be easily covered under the unit would be - a) The global water cycle and water distribution. b) The human right to water c) Importance of water-related ecosystems. d) water exports e) Water as a finite resource.

For grade 3 (year 8-9), under the theme **"Who We Are"** - unit name is "Children's rights" which talks about children have rights and responsibilities that enable them to participate in community life. For this I have suggested the sustainable development goal number - 5 "Gender Equality" - Achieve gender equality and empower all women and girls. The topics which can be easily covered under this unit would be - a) Gender inequality, traditional gender roles and structural discrimination. b) Exploitation and trafficking of women and girls. c) Education, including gender equality in all the levels of education (Primary, middle and higher).

Another important theme for the similar grade would be - "**How We Organize Ourselves"** - unit name is - "Economics" it talks about equitable societies can be created through equal distribution of resources. For this I have suggested the sustainable development goal number - 8 "Decent Work and Economic Growth" - Promote inclusive and sustainable economic growth, and productive and decent employment work for all according to their skills. The topics which can easily be covered under this unit would be - a) Economic ethics b) The contributions of economies to human well-being, and the social and individual effects of unemployment. c) Entrepreneurship, innovation, and new technologies.

For grade 4 (year 9-10), under the theme **"Who We Are"** - unit name is "Health and Well-being" which talks about how health and well-being depends on various physical and environmental factors. For this I have suggested the sustainable development goal number - 3 "Good health and Well-being" - Ensure healthy lives and promote well-being for all at all ages. The topics which can be easily covered under this unit would be - a) Health problems in vulnerable regions. b) Overweight and obesity. c) Severe communicable and non-communicable diseases. d) Strategies to promote health and well-being.

Another important theme for the similar grade would be - "**Sharing the Planet"** - unit name is - "Sustainability" it talks about how people make choices to support the sustainability of earth's resources. For this I have suggested the sustainable development goal number - 11 " Sustainable cities and communities". The topics which can be easily covered under this unit would be - a) Management and the use of natural resources. b) Sustainable food c) Water cycle and restoring groundwater through urban design. d) Sustainable energy e) The need for shelter, safety and inclusiveness.

For grade 5 (year 10-11), under the theme **"How the World Works"** - unit name is "Design" it talks design depends on environmental factors and human ingenuity. For this I have suggested the sustainable development goal number - 9 "Industry innovation and infrastructure" - Build infrastructure, promote inclusive and sustainable structures and foster new technology. The topics which can be easily covered under this unit would be - a) The relation of aesthetic infrastructure and the achievement of social, economic and political goals. b) Inclusive and sustainable innovation and industrialization. c) The sustainable job markets.

Another important theme for the similar grade would be - "**Sharing the Planet"** - unit name is - "Peace and Justice" which talks about resolving conflicts maintaining peace can lead to a better quality of life. For this I have suggested the sustainable development goal number - 16 "Peace, Justice and Strong institutions". The topics which can be easily covered under this unit would be - a) Definition of justice, retributive and rehabilitative. b) Climate justice c) Trade justice d) Corruption and how to measure it. e) Crime and punishment.

Though, every unit in each grade and theme can be linked easily with these sustainable development goals for education but here we would specifically like to mention which are directly talking about changing in actions for a humankind to improve this change in climate.

This is a suggested curriculum for IB PYP which is directly linked up with sustainable development educational goals. This curriculum will help the teachers to teach students with the current issues happening around the world. Students can further decide their action plan according to their understanding.

Conclusion:

The purpose of the present research was to spread awareness among teachers that it is a high time to change in our actions. So the students can learn about the variations in climate change at an early stage and reflect

on their actions. We personally feel that there will be several limitations during the implementation of this curriculum which need to be acknowledged like an expert curriculum designer in a school can modify their school's curriculum according to the learner's need, student's actions should be clearly addressed in every unit, teachers require professional development sessions to learn how can they address and integrate SDGs in their unit, etc. This might be cumbersome and time consuming for the schools. Hiring professionals and arranging professional development sessions will bring extra cost to the authority. In such case, we don't know how far this would be applicable and taken care of?

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IMPACT ON GLACIER AND ICE MELT IN COMBATING CLIMATE CHANGE: A STUDY TOWARDS FUTURE RESEARCH

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Summary
Climate Change is an impact of Global warming and due to this Glaciers and Ice-lands / Caps are melting very fast. Consequently, weather and climate are badly damaged. Storms are a fact of life for Curole. Even relatively small storm surges in the past two decades have overwhelmed the system of dikes, levees, and pump stations that was managed, upgraded in the 1990s to forestall the Gulf of Mexico's relentless creep.

The current trend is consequential not only in coastal Louisiana but around the world. Never before have had so many humans lived so close to the coasts: More than a hundred million people worldwide live within three feet (a meter) of mean sea level. Vulnerable to sea-level rise, Tuvalu, a small country in the South Pacific, has already begun formulating evacuation plans. Megacities where human populations have concentrated near coastal plains or the river deltas — Shanghai, Bangkok, Jakarta, Tokyo, and New York — are at risk. The projected economic and humanitarian impacts on low-lying, densely populated, and desperately poor countries like Bangladesh are potentially catastrophic. The scenarios are disturbing even in wealthy countries like the Netherlands, with nearly half its landmass already at or below sea level.

India has a total coastline of 7516.6 km, out of which mainland coastline consists of 6100 km and islands' coastline consists of 1197 km. Indian coastline touches nine states and four union territories. The nine states are Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal, need evacuation every year during cyclone / hurricane as frequency is increasing.

1.0 Introduction

During continual researches, scientists are finding that glaciers reveal clues about global warming. How much does our atmosphere naturally warm up between Ice Ages? How does human activity affect climate? Because glaciers are so sensitive to temperature fluctuations accompanying climate change, direct glacier observation may help answer these questions. Since the early twentieth century, with few exceptions, glaciers around the world have been retreating at unprecedented rates. Some scientists attribute this massive glacial retreat to the Industrial Revolution, which began around 1760. In fact, several ice caps, glaciers and ice shelves have disappeared altogether in this century. Many more are retreating so rapidly that they may vanish within a matter of decades.

Scientists are discovering that production of electricity using coal and petroleum, and other uses of fossil fuels in transportation and industry, affects our environment in ways we did not understand before. Within the past 200 years or so, human activity has increased the amount of carbon dioxide in the atmosphere by 40 percent, and other gases, such as methane (natural gas) by a factor of 2 to 3 or more. These gases absorb heat being radiated from the surface of the earth, and by absorbing this heat the atmosphere slowly warms up. Heat-trapping gases, sometimes called “greenhouse gases,” are the cause of most of the climate warming and glacier retreat in the past 50 years. However, related causes, such as increased dust and soot from

grazing, farming, and burning of fossil fuels and forests, are also causing glacier retreat. In fact, it is likely that the earliest parts of the recent glacier retreats in Europe were caused by soot from coal burning in the late 1800s.

As dramatic as the retreat of one glacier may be, scientists learn the most about global climate by studying many glaciers. The World Glacier Monitoring Service (WGMS) tracks changes in more than 100 alpine glaciers worldwide. Forty-two of those glaciers qualify as climate reference glaciers because their records span more than 30 years.

The WGMS reports, glacier mass balance changes in millimetres of water equivalence. (There are 25.4 millimetres in an inch.) If all the lost or gained glacial ice were converted to water and spread evenly over glacier surface area, the depth of that water layer is the water equivalence. In State of the Climate in 2018, the American Meteorological Society reported that mean annual glacier mass balance was (-) 921 millimetres for the 42 reference glaciers, and (-) 951 millimetres for all glaciers monitored in 2017.

Daniel Fagre quotes “If we don't have it, we don't need it," as we throw on our backpacks. We're armed with crampons, ice axes, rope, GPS receivers, and bear spray to ward off grizzlies, and we're trudging toward Sperry Glacier in Glacier National Park, Montana. It falls in step with Fagre and two other research scientists from the U.S. Geological Survey Global Change Research Program. They're doing what they've been doing for more than a decade: measuring how the park's storied glaciers are melting. So far, the results have been positively chilling. When President Taft created Glacier National Park in 1910, it was home to an estimated 150 glaciers. Since then the number has decreased to fewer than 30, and most of those remaining have shrunk in area by two-thirds (67%). Fagre predicts that within 30 years most if not all of the park's namesake glaciers will disappear.

"This glacier used to be closer," scientists says as we crest a steep section. A trailside sign notes that since 1901, Sperry Glacier has shrunk from more than 800 acres (320 hectares) to 300 acres (120 hectares). "That's out of date," to stopping to catch back its position, as it is now less than 250 acres (100 hectares)."

"Things that normally happen in geologic time are happening during the span of a human lifetime," says Fagre **[1-2]**.

2.0 Glacier & Ice-melt Impacts Climate

Scientists assess the planet's health see indisputable evidence that Earth has been getting warmer, in some cases rapidly. Most believe that human activity, in particular the burning of fossil fuels and the resulting build-up of greenhouse gases in the atmosphere, have influenced this warming trend. In the past decade scientists have documented record-high average annual surface temperatures and have been observing other signs of change all over the planet: in the distribution of ice, and in the salinity, levels, and temperatures of the oceans.

Fig 1: Polar ice caps in Greenland, Antarctica, melting 6 times faster than in 1990s

Everywhere on Earth ice is changing. The famed snows of Kilimanjaro have melted more than 80 percent since 1912. Glaciers in the Garhwal Himalaya in India are retreating so fast that researchers believe that most central and eastern Himalayan glaciers could virtually disappear by 2035. Arctic sea ice has thinned significantly over the past half century, and its extent has declined by about 10 percent in the past 30 years. NASA's repeated laser altimeter readings show the edges of Greenland's ice sheet shrinking. Spring freshwater ice breakup in the Northern Hemisphere now occurs nine days earlier than it did 150 years ago, and autumn freeze-up ten days later. Thawing permafrost has caused the ground to subside more than 15 feet (4.6 meters) in parts of Alaska. From the Arctic to Peru, from Switzerland to the equatorial glaciers of Man Jaya in Indonesia, massive ice fields, monstrous glaciers, and sea ice are disappearing, fast.

When temperatures rise and ice melts, more water flows to the seas from glaciers and ice caps, and ocean water warms and expands in volume. This combination of effects has played the major role in raising average global sea level between four and eight inches (10 and 20 centimetres) in the past hundred years, according to the Inter-governmental Panel on Climate Change (IPCC).

Scientists point out those sea levels have risen and fallen substantially over Earth's 4.6-billion-year history. But the recent rate of global sea level rise has departed from the average rate of the past two to three thousand years and is rising more rapidly—about one-tenth of an inch a year. A continuation or acceleration of that trend has the potential to cause striking changes in the world's coastlines.

Driving around Louisiana's Gulf Coast, Windell Curole can see the future, and it looks pretty wet. In southern Louisiana coasts are literally sinking by about three feet (a meter) a century, a process called subsidence. A sinking coastline and a rising ocean combine to yield powerful effects. It's like taking the global sea-level-rise problem and moving it along at fast-forward.

The seventh-generation Cajun and manager of the South Lafourche Levee District navigates his truck down an unpaved mound of dirt that separates civilization from inundation, dry land from a swampy horizon. With his French-tinged lilt, Curole points to places where these bayous, swamps, and fishing villages portend a warmer world: his high school girlfriend's house partly submerged, a cemetery with water lapping against the white tombs, his grandfather's former hunting camp now afloat in a stand of skeleton oak snags. "We live in a place of almost land, almost water," says the 52-year-old Curole.

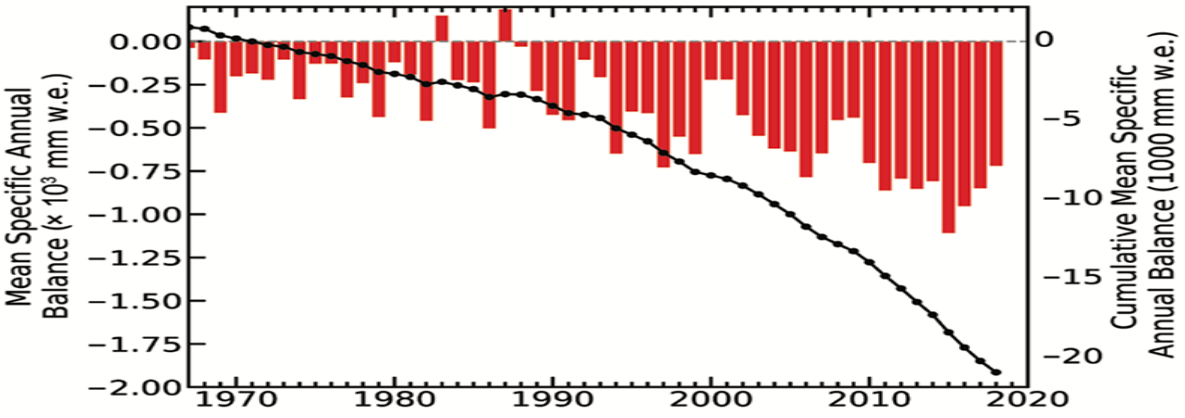

Figure 2: Mass balance of the World Glacier Monitoring Service (WGMS)
Credit: State of the Climate in 2018. Bull. Amer. Meteor. Soc

The above **Fig.2** shows that mass balance of World Glacier Monitoring Service in which 37 reference glaciers are considered each year since 1968 (red bars), along with the total mass loss over time (black line), which is updated on 16 March 2020.

2.1 Weather versus Climate

2.1.1 What is the difference between weather and climate?[3]

Weather is the day-to-day state of the atmosphere, and its short-term variation in minutes to weeks. People generally think of weather as the combination of temperature, humidity, precipitation, cloudiness, visibility, and wind. We talk about changes in weather in terms of the near future: "How hot is it right now?" "What will it be like today?" and "Will we get a snowstorm this week?"

Climate is the weather of a place averaged over a period of time, often 30 years. Climate information includes the statistical weather information that tells us about the normal weather, as well as the range of weather extremes for a location.

We talk about climate change in terms of years, decades, centuries, even millions of years. Scientists study climate to look for trends or cycles of variability, such as the changes in wind patterns, ocean surface temperatures and precipitation over the equatorial Pacific that result in El Niño and La Niña, and also to place cycles or other phenomena into the bigger picture of possible longer term or more permanent climate changes **[4]**.

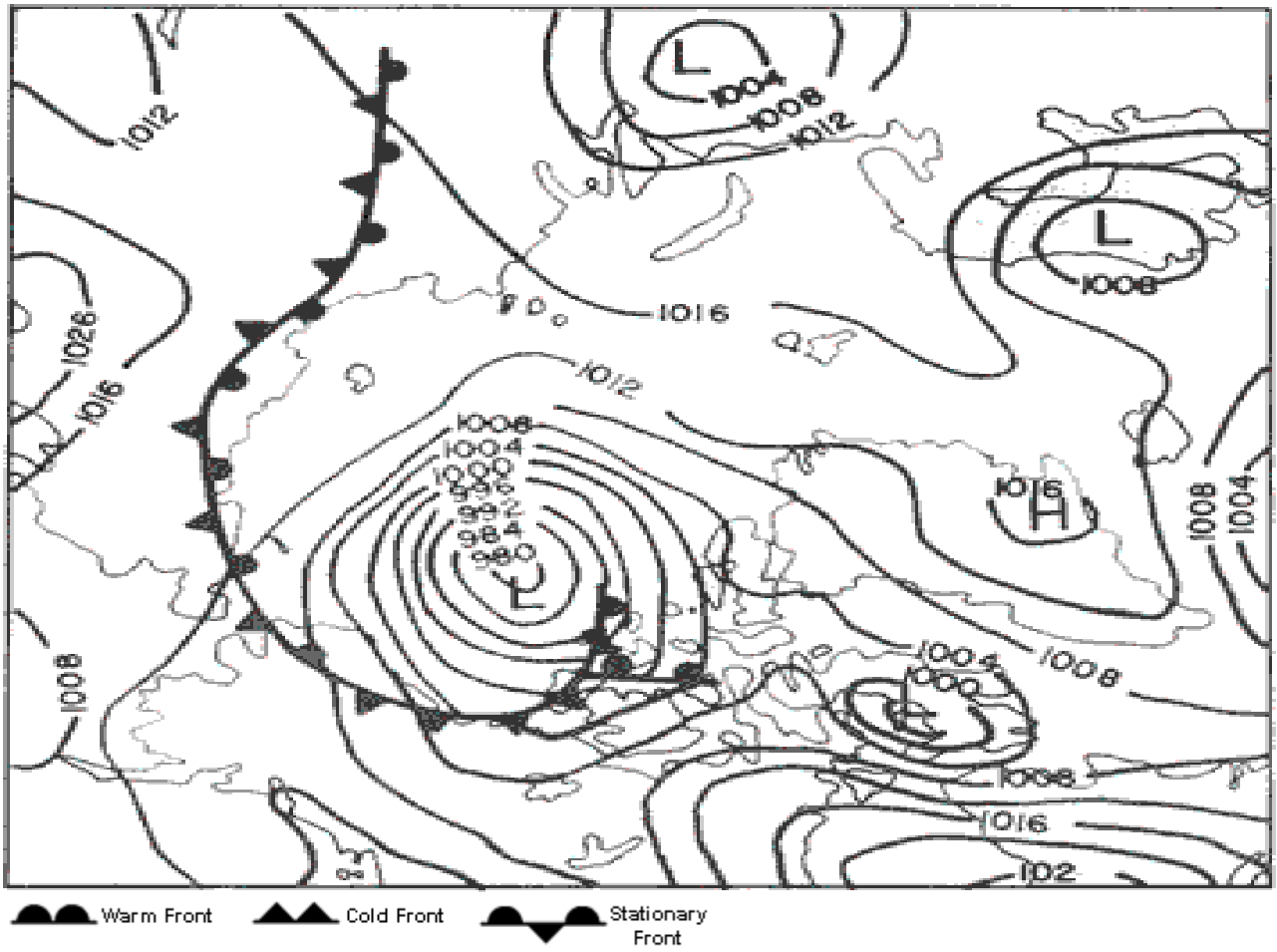

Figure 3: A synoptic chart for 28 August 1980
Credit: M. Serreze and R. Barry (1988).

2.1.2 Forecasting weather and predicting climate

Weather forecasters try to answer questions like: What will the temperature be tomorrow? Will it rain? How much rain will we have? Will there be thunderstorms? Today, most weather forecasts are based on numerical models, which incorporate observations of air pressure, temperature, humidity and winds to produce the best estimate of current and future conditions in the atmosphere. A weather forecaster then looks at the model output to figure out the most likely scenario. The accuracy of weather forecast depends on both the model and on the forecaster's skill. Short-term weather forecasts are accurate for up to a week. Long-term forecasts, for example seasonal forecasts, tend to use statistical relationships between large-scale climate signals such as El Niño and La Niña and precipitation and temperature to predict what the weather will be like in one to six months' time**.**

Forecasts — whether generated by artificial intelligence, meteorologists, or indigenous elders — often rely on past weather patterns to predict the future, but climate change is making the past a less effective predictor of the future.

Climate predictions take a much longer-term view. These predictions try to answer questions like how much warmer will the Earth be 50 to 100 years from now? How much more precipitation will there be? How much will sea level rise? Climate predictions are made using global climate models. Unlike weather forecast models, climate models cannot use observations because there are no observations in the future.

2.2 Arctic Climate

Like other places on Earth, the weather in the Arctic varies from day to day, from month to month, and from place to place. But the Arctic is a unique place for weather and climate, because of the special factors that influence it. Sunlight is perhaps the most important of those factors. Above the Arctic Circle, the sun disappears in the winter, leaving the region dark and cold. What light does reach the region in the winter comes in at a low angle. In summers, the sun shines around the clock, bringing warmth and light. The Arctic also experiences frequent inversions. Inversions occur when cold air settles close to the ground, with warm air on top of it. Inversions separate the air into two layers, like oil and water: this tends to slow down the winds close to the surface. Over cities, inversions can trap pollutants, creating smoggy conditions that last until the inversion clears **[4-5]**.

Scientists separate the Arctic into two major climate types. Near the ocean, a maritime climate prevails. In Alaska, Iceland, and northern Russia and Scandinavia, the winters are stormy and wet, with snow and rainfall reaching 60 cm (24 inches) to 125 cm (49 inches) each year. Summers in the coastal regions tend to be cool and cloudy; average temperatures hover around 10 degrees Celsius (50 degrees Fahrenheit).

Figure 4: An inversion layer. —*Credit: Willie Angus*.

Away from the coasts, the interior regions of the Arctic lands have a continental climate. The weather is dryer, with less snow in the winter and sunny summer days. Winter weather can be severe, with frigid temperatures well below freezing. In some regions of Siberia, average January temperatures are lower than (-) 40 degrees Celsius [(-) 40 degrees Fahrenheit]. In the summer, the long days of sunshine thaw the top layer of permafrost and bring average temperatures above 10 degrees Celsius (50 degrees Fahrenheit). At some weather stations in the interior, summer temperatures are warmer than 30 degrees Celsius (86 degrees Fahrenheit).

3.0 Rising Sea Level

Rising sea level, sinking land, eroding coasts, and temperamental storms are a fact of life. Even relatively small storm surges in the past two decades have overwhelmed the system of dikes, levees, and pump stations that he manages, upgraded in the 1990s to forestall the Gulf of Mexico's relentless creep. "It could have been probably more evacuations than any other person in the country- says Curole".

The current trend is consequential not only in coastal Louisiana but around the world. Never before have had so many humans lived so close to the coasts: More than a hundred million people worldwide live within three feet (a meter) of mean sea level. Vulnerable to sea-level rise, Tuvalu, a small country in the South Pacific, has already begun formulating evacuation plans. Megacities where human populations have concentrated near coastal plains or the river deltas- Shanghai, Bangkok, Jakarta, Tokyo, and New York; are at risk. The projected economic and humanitarian impacts on low-lying, densely populated, and desperately poor countries like Bangladesh are potentially catastrophic. The scenarios are disturbing even in wealthy countries like the Netherlands, with nearly half its landmass already at or below sea level.

Rising sea level produces a cascade of effects. Bruce Douglas, a coastal researcher at Florida International University, calculates that every inch (2.5 centimeters) of sea-level rise could result in eight feet (2.4 meters) of horizontal retreat of sandy beach shorelines due to erosion. Furthermore, when salt water intrudes into freshwater aquifers, it threatens sources of drinking water and makes raising crops problematic. In the Nile Delta, where many of Egypt's crops are cultivated, widespread erosion and saltwater intrusion would be disastrous since the country contains little other arable land.

In some places marvels of human engineering worsen effects from rising seas in a warming world. The system of channels and levees along the Mississippi effectively stopped the millennia-old natural process of rebuilding the river delta with rich sediment deposits. In the 1930s oil and gas companies began to dredge shipping and exploratory canals, tearing up the marshland buffers that helped dissipate tidal surges. Energy drilling removed vast quantities of subsurface liquid, which studies suggest increased the rate at which the land is sinking. Now Louisiana is losing approximately 25 square miles (65 square kilometres) of wetlands every year, and the state is lobbying for federal money to help replace the upstream sediments that are the delta's lifeblood.

Local projects like that might not do much good in the very long run, though, depending on the course of change elsewhere on the planet. Part of Antarctica's Larsen Ice Shelf broke apart in early 2002. Although floating ice does not change sea level when it melts (any more than a glass of water will overflow when the ice cubes in it melt), scientists became concerned that the collapse could foreshadow the breakup of other ice shelves in Antarctica and allow increased glacial discharge into the sea from ice sheets on the continent. If the West Antarctic ice sheet were to break up, which scientists consider very unlikely this century, it alone contains enough ice to raise sea level by nearly 20 feet (6 meters).

Even without such a major event, the IPCC

projected in its 2001 report that sea level will rise anywhere between 4 and 35 inches (10 and 89 centimeters) by the end of the century. The high end of that projection—nearly three feet (a meter)—would be "an unmitigated disaster," according to Douglas.

Down on the criticalities, all of those predictions make Windell Curole shudder. "We're the guinea pigs," – Curole says surveying aqueous world from the relatively lofty vantage point of a 12-foot-high (3.7-meter) earthen berm mound. "I don't think anybody down here looks at the sea-level-rise problem and puts their heads in the sand." That's because soon there may not be much sand left.

Rising sea level is not the only change Earth's oceans are undergoing. The ten-year-long World Ocean Circulation Experiment, launched in 1990, has helped researchers to better understand what is now called the ocean conveyor belt.

Oceans, in effect, mimic some functions of the human circulatory system. Just as arteries carry oxygenated blood from the heart to the extremities, and veins return blood to be replenished with oxygen, oceans provide life-sustaining circulation to the planet. Propelled mainly by prevailing winds and differences in water density, which changes with the temperature and salinity of the seawater, ocean currents are critical in cooling, warming, and watering the planet's terrestrial surfaces—and in transferring heat from the Equator to the Poles.

4.0 India's Coastline and Amazing Facts

India has major part of its land covered by water. So development of ports, coastal connectivity, shipping industry and coastal economic zones are some of the crucial departments that government needs to stress upon.

The central government has taken a lot of efforts to develop India's coastline. To analyse the same, Free Press Journal has organised a panel discussion named 'India's Coastline – Engine and Wheel of Economic Growth' in which questions like, how much has India achieved during the past four years, and how can India make all these sectors grow better and thus make India that much more vibrant will be discussed **[7].**

4.1 Some Interesting and Lesser Known Facts about India's Coastline

- India has a total coastline of 7516.6 km, out of which mainland coastline consists of 6100 km and islands' coastline consists of 1197 km.
- Indian coastline touches nine states and four union territories. The nine states are Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal. Union Territories include Daman & Diu, Puducherry, Andaman & Nicobar Islands and Lakshadweep Islands.
- Gujarat has the longest sea coastline in India of 1,600 km.
- It is believed that formation of coastline of India is the result of continental drift of Gondwanaland.
- India's mainland coastline is divided into two parts- Eastern coastline and Western coastline.
- Large parts of the coastal plains of India are covered by fertile soils on which different crops are grown. Rice is the main crop of these areas.
- Fishing is an important occupation of the people living in the coastal areas of India.
- The Eastern coastline includes Eastern Ghats and the Bay of Bengal and extends from Ganga Delta in the North to Kanyakumari in the South.
- The Eastern coastline can be divided into three parts according to states, Orissa coastal plain, Andhra coastal plain and Tamil Nadu coastal plain.
- The Eastern coastline of India consists of rivers like the Mahanadi, the Godavari, the Krishna and the Cauvery.
- The Western coastline, on the other

hand, extends from Rann of Kachchh in the north to Kanyakumari in the South.

- It is divided into three parts, Konkan coast, the Karnataka coast and Kerala coast.
- Western coastline consists of the Indian Ocean, which is the only ocean to be named after a country.
- Coconut trees grow all along the Western coast. The sands of Kerala coast have large quantity of Monazite, which is used for nuclear power. Low lying areas of Gujarat are famous for producing salt.

Figure 5: Alphan Cyclone hit West Bengal on 16th May 2020

4.2 About India's Coastline — Engine and Wheel of Economic Growth

The Free Press Journal in association with JNPT had organized a conference on INDIA'S COASTLINE – ENGINE AND WHEEL OF ECONOMIC GROWTH at ITC Grand Central, Parel in Mumbai on October 22, 2018 at 2:30 pm onwards. Union Minister for Road Transport & Highways, Shipping and Water Resources, River Development & Ganga Rejuvenation Nitin Gadkari was be the Chief Guest and Keynote Speaker.

The engine running the conveyor belt is the density-driven thermohaline circulation ("thermo" for heat and "haline" for salt). Warm, salty water flows from the tropical Atlantic north toward the Pole in surface currents like the Gulf Stream. This saline water loses heat to the air as it is carried to the far reaches of the North Atlantic. The coldness and high salinity together make the water denser, and it sinks deep into the ocean. Surface water moves in to replace it. The deep, cold water flows into the South Atlantic, Indian, and Pacific Oceans, eventually mixing again with warm water and rising back to the surface.

Changes in water temperature and salinity, depending on how drastic they are, might have considerable effects on the ocean conveyor belt. Ocean temperatures are rising in all ocean basins and at much deeper depths than previously thought, say scientists at the National Oceanic and Atmospheric Administration (NOAA). Arguably, the largest oceanic change ever measured in the era of modern instruments is in the declining salinity of the sub-polar seas bordering the North Atlantic.

Robert Gagosian, president and director of the Woods Hole Oceanographic Institution, believes that oceans hold the key to potential dramatic shifts in the Earth's climate. He warns that too much change in ocean temperature and salinity could disrupt the North Atlantic thermohaline circulation enough to slow down or possibly halt the conveyor belt—causing drastic climate changes in time spans as short as a decade.

The future breakdown of the thermohaline circulation remains a disturbing, if remote, possibility. But the link between changing atmospheric chemistry and the changing oceans is indisputable, says Nicholas Bates, a principal investigator for the Bermuda Atlantic Time-series Study station, which monitors the temperature, chemical composition, and salinity of deep-ocean water in the Sargasso Sea southeast of the Bermuda Triangle.

5.0 Absorption of Carbon Dioxide

Oceans are important sinks, or absorption centers, for carbon dioxide, and take up about a third of human-generated CO2. Data from the Bermuda monitoring programs show that CO2 levels at the ocean surface are rising at about the same rate as atmospheric CO2. But it is in the deeper levels where Bates has observed even greater change. In the waters between 820 and 1,476 feet (250 and 450 meters) deep, CO2 levels are rising at nearly twice the rate as in the surface waters. "It's not a belief system; it's an observable scientific fact," Bates says. "And it shouldn't be doing that unless something fundamental has changed in this part of the ocean."

While scientists like Bates monitor changes in the oceans, others evaluate CO2 levels in the atmosphere. In Vestmannaeyjar, Iceland, a lighthouse attendant opens a large silver suitcase that looks like something out of a James Bond movie, telescopes out an attached 15-foot (4.5-meter) rod, and flips a switch, activating a computer that controls several motors, valves, and stopcocks. Two two-and-a-half liter (about 26 quarts) flasks in the suitcase fill with ambient air. In North Africa, an Algerian monk at Assekrem does the same. Around the world, collectors like these are monitoring the cocoon of gases that compose our atmosphere and permit life as we know it to persist **[8-15**].

When the weekly collection is done, all the flasks are sent to Boulder, Colorado. There, Pieter Tans, a Dutch-born atmospheric scientist with NOAA's Climate Monitoring and Diagnostics Laboratory, oversees a slew of sensitive instruments that test the air in the flasks for its chemical composition. In this way Tans helps assess the state of the world's atmosphere **[16].**

5.1 By all accounts it has changed significantly in the past 150 years.

Walking through the various labs filled with cylinders of standardized gas mixtures, absolute manometers, and gas chromatographs, Tans offers up a short history of atmospheric monitoring. In the late 1950s a researcher named Charles Keeling began measuring CO2 in the atmosphere above Hawaii's 13,679-foot (4,169-meter) Mauna Loa. The first thing that caught Keeling's eye was how CO2 level rose and fell seasonally. That made sense since, during spring and summer, plants take in CO2 during photosynthesis and produce oxygen in the atmosphere. In the fall and winter, when plants decay, they release greater quantities of CO2 through respiration and decay. Keeling's vacillating seasonal curve became famous as a visual representation of the Earth "breathing [**17]**.

Table 1: 100-Year Global Warming Potential (GWP)
Selected compounds (per kg.)

SNo.	Name	Formula	GWP
1.	Carbon Dioxide	CO2	1
2..	Mrthane	CH4	28
3.	Nitrous Oxide	N2O	265
4.	HCFCs	Various	80-2,000
5.	HFcs	Various	4-12,400
6.	CFCs	Various	4,600-14.000
7.	Nitrogen Trifloride	NF3	16,100
8.	Trifluoromethyl Sulfer Pentafluoride	SFSCF3	17,400
9.	Sulfur Hexafluoride	SF6	23,500

Something else about the way the Earth was breathing attracted Keeling's attention. He watched as CO2 level not only fluctuated seasonally, but also rose year after year. Carbon dioxide level / concentration has climbed from about 315 parts per million (ppm) from Keeling's first readings in 1958 to more than 375 ppm today. A primary source for this rise is indisputable: humans' prodigious burning of carbon-laden fossil fuels for their factories, homes, and cars.

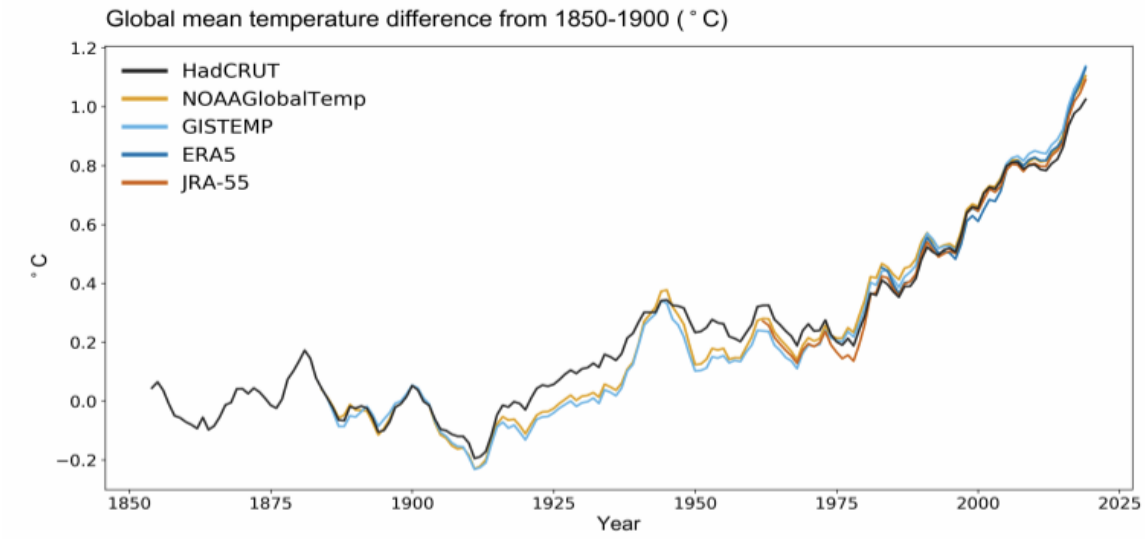

Figure 6: Global Climate in 2015-2019: Climate change accelerates
(Copyrighted Source: Met Office)

Tans shows a graph depicting levels of three key greenhouse gases—CO2, methane, and nitrous oxide—from the year 1000 to the present. The three gases together help keep Earth, which would otherwise be an inhospitably cold orbiting rock, temperate by orchestrating an intricate dance between the radiation of heat from Earth back to space (cooling the planet) and the absorption of radiation in the atmosphere (trapping it near the surface and thus warming the planet) [**18-24**].

6.0 Future Impact on Climate Change

Tans and most other scientists believe that greenhouse gases are at the root of our changing climate. "These gases are a

climate-change driver," says Tans, poking his graph definitively with his index finger. The three lines on the graph follow almost identical patterns: basically flat until the mid-1800s, then all three moves upward in a trend that turns even more sharply upward after 1950. "This is what we did," says Tans, pointing to the parallel spikes. "We have very significantly changed the atmospheric concentration of these gases. We know their radiative properties," he says. "It is inconceivable to me that the increase would not have a significant effect on climate."

Exactly how large that effect might be on the planet's health and respiratory system will continue to be a subject of great scientific and political debate—especially if the lines on the graph continue their upward trajectory.

Eugene Brower, an Inupiat Eskimo and president of the Barrow Whaling Captains' Association, doesn't need fancy parts-per-million measurements of CO2 concentrations or long-term sea-level gauges to tell him that his world is changing.
"It's happening as we speak," the 56-year-old Brower says as we drive around his home in Barrow, Alaska—the United States' northernmost city—on a late August day. In his fire chief's truck, Brower takes me to his family's traditional ice cellars, painstakingly dug into the permafrost, and points out how his stores of muktuk—whale skin and blubber-- recently began spoiling in the fall because melting water drips down to his food stores. Our next stop is the old Bureau of Indian Affairs school building. The once impenetrable permafrost that kept the foundation solid has bucked and heaved so much that walking through the school is almost like walking down the halls of an amusement park fun house. We head to the eroding beach and gaze out over open water. "Normally by now the ice would be coming in," Brower says, scrunching up his eyes and scanning the blue horizon.

We continue our tour. Barrow looks like a coastal community under siege. The ramshackle conglomeration of weather-beaten houses along the seaside gravel road stands protected from fall storm surges by miles-long berms of gravel and mud that block views of migrating gray whales. Yellow bulldozers and graders patrol the coast like sentries.

The Inupiat language has words that describe many kinds of ice. *Piqaluyak* is salt-free multiyear sea ice. *Ivuniq* is a pressure ridge. *Sarri* is the word for pack ice, *tuvaqtaq* is bottom-fast ice, and shore-fast ice is *tuvaq*. For Brower, these words are the currency of hunters who must know and follow ice patterns to track bearded seals, walruses, and bowhead whales.

There are no words, though, to describe how much, and how fast, the ice is changing. Researchers long ago predicted that the most visible impacts from a globally warmer world would occur first at high latitudes: rising air and sea temperatures, earlier snowmelt, later ice freeze-up, reductions in sea ice, thawing permafrost, more erosion, and increases in storm intensity. Now all those impacts have been documented in Alaska. "The changes observed here provide an early warning system for the rest of the planet," says Amanda Lynch, an Australian researcher who is the principal investigator on a project that works with Barrow's residents to help them incorporate scientific data into management decisions for the city's threatened infrastructure.

Before leaving the Arctic, I drive to Point Barrow alone. There, at the tip of Alaska, roughshod hunting shacks dot the spit of land that marks the dividing line between the Chukchi and Beaufort Seas. Next to one shack someone has planted three eight-foot (2.4-meter) sticks of white driftwood in the sand, then crisscrossed their tops with whale baleen, a horny substance that whales of the same name use to filter life-sustaining plankton out of seawater. The baleen, curiously, looks like palm fronds.

So there, on the North Slope of Alaska, stand three makeshift palm trees. Perhaps they are no more than an elaborate Inupiat joke, but

these Arctic palms seem an enigmatic metaphor for the Earth's future. There is bigger question – *What would be the existence of living creature on the earth during next century?* [**25-30**].

7.0 Conclusion

From the above recent study, it is found that major causes of rising the fever of earth is; due to exploitation of our earth minerals and hydrocarbons especially: Coal, Crude oil, Diesel, Petrol and Gases, being used in transport and industries for generation of mechanical and electrical energy and also un-organized way of developments without balancing nature damage. Thus following points are concluded:

- Mass balance of World Glacier Monitoring Service shows that glaciers will be a history within few decades on the earth as per recent decline recorded on 16th March 2020.
- Rising of sea level produces a cascade effects, which shows that every inch (2.5 centimeters) of sea-level rise could result in eight feet (2.4 meters) of horizontal retreat of sandy beach shorelines due to erosion?. It will submerge most of the low-lying coastal areas of courtiers surrounded by the ocean, Like: India, Japan, Thailand, and Netherlands etc.[**3]**
- Severe cyclone, Hurricane, Tsunamis, Heavy Snow fall, Rainfall and Earthquakes etc. will create major causalities all over the world **[31].**
- Every year major funds will be pumped to disaster management to evacuate people from coastal area to safer places [**32**].
- Countries like: USA, Canada, France, Britain, Germany, Italy etc. will face severe cold waves, snow fall, heavy down pour and living will not be conducive, people will be forced to mitigate to find new safer place [**32**].

According to my earlier researches, there is one future projection – as earth speed is likely reducing in milliseconds that will create more challenges to face earth quake of high rector. As sea level is rising- radii of earth at lateral axis, create more friction impacts; ultimately it may likely to reduce the earth speed [**32**].

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FOR DEVELOPMENT PURPOSE: ENVIRONMENT AND FINANCIAL INCLUSION

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Economic development refers to transform in increasing domestic product and accomplishment of basic needs of a country for a particular time period. Economic development submits to environmental situation and financial inclusion circumstances of the country. Financial inclusion helps to fulfil sustainable development goals by the year 2030. Still 44 percent people of the total population of the country is unbanked. Bangladesh Bank (Central bank of Bangladesh) established Financial Inclusion Department in July 2015 with two wings: Financial Inclusion Wing and Supervision and Innovation Wing. In Bangladesh, Mobile Financial Services which is also known as mobile banking is gradually gaining popularly. According to The Business Standard (April13,2020), now 15 banks provide mobile financial services, and they have 2.70 crore active client accounts in Bangladesh and in February, the average daily transaction through mobile banking was Tk1,425 crore. However, due to COVID 19, Mobile banking services were disrupted both the customer and vendors end due to lockdown/shutdown or diving the country to save people by declaring red zone in some areas due to community transmission of corona virus. Meanwhile, Dhaka Tribune (12 January,2020) reported that as of December 31, 2019, twenty-eight banks have got permission from the Bangladesh Bank(central bank of Bangladesh) to open sub-branch and of them 22 banks have already opened sub-branch services in rural and industrial areas Irony is that NRB Commercial Bank has the highest 147 sub-branches in operation in the country till January 12,2020 according to the report and the bank collected about BDT .300croer as deposits from the sub-branches while they disbursed loans to the tune of around BDT 22 crore which indicated only 7.33 Percent was invested through this sub branches which is very negligible amount. Ultimately good intention becoming in vain due to flight of the capital from the rural areas are occurring through these sub branches.

The rationale of the procedure of examining environmental scenario has been offering the economic enhancement with the bidirectional way to the adjustment the probable happening in the organizations are to go on righteous manner. Consequently, this approach can become accustomed with the production process to get the better of the intimidation and taking advantage of the chance is impending on the system. Expansion of financial inclusion can alleviate recognition to restraint on commercial behaviour by tumbling in sequence of irregularity in monetary dealings, and in adding up this result is superior in production by means of subordinate fence to access. The growth of financial inclusion is frequently helpful to the arrangement of economic scenario of the country in segment with significant manner to access from the barrier. Financial Inclusion helps to promotes innovation, increasing credit access to allow the upper income strata of the people which substantially increase profits availability and credit led to higher self-employment and business ownership may rise. The accessibility of credit allows to financing sustainability up-gradation. Through CSMEs women can expand and rise investment in their businesses process. Unbanked people are highly correlated to the environmental scenario of low progress of formal business. Informal expansion doesn't have too much sustainable situation in the business process.

Weak rule of law leaves banks reluctant to lend low income strata people. Economics

sustainability upgrades among CSMEs Financial services to assist people: - create investments to get away from burden of poverty - survive economic shocks & avoid becoming have-nots and pauperization. Financial inclusion ways that people have access and can effectively use appropriate financial services. Such services must be provided responsibly and sustainably in a well-regulated environmental framework. Too ease doing business environment is very much important. To slot in environmental eminence is concerning on keen to the economic analysis of projects, programs, and development strategies. The relationship between certain indicators of environmental quality and income, ultimate that mostly an inverted-U shaped link, which has been called as an environmental Kuznets curve (EKC).Environmental sustainability refers to the income-environment relationship is motionless awfully difficult and so as to unwavering environmental strategy will be necessary if prospect of income enlargement is to be well-matched with sustainable expansion. Precise connections flanked by a purpose calculate to supporting constraint and disparity in national growth rates. Pollution is linked to the scale of production where optimum scale of plant cannot be attained. It has a depressing collision situation on output together in steadfastly energetic manners and in the intelligence technique. This consequence will mitigate by disruptive actions of the competence of which can better by spending in disruptive technology. A reduced amount of pollution is linked with elevated enlargement in the stable procedure. In addition, at the small period there may be most advantageous government rules with esteem to disruption and taxation. "Economic force Enterprise" who may take action because one-stop services for all the monetary requirements of their rural community, including: microcredit, appropriate financing, insurance, small banking, savings schemes and remittances. Need to integrate its economic services offering in a value addition process with its recognized business to allow financial inclusion at a low cost, while empowering entrepreneurs and promoting bottom up economic growth. But this may be in the formal sector. What will be the scenario of informal sector where around 6.5 crore people in Bangladesh depends? Societal banking idea is larger than agent banking or mobile banking specially to look into the matter in the informal sector. It will give the scope of financial inclusion and currently 83% people who are working informal sector will gradually transform to the formal sector in Bangladesh. It will help to transform micro savings into micro investment, improve local economy and empower people in the community. Societal banking framework should be developed under a regulatory framework may work starting in joint effort of PaliSanchya bank, Karmasonsthan bank and postal savings deposit and creating investment sector. Social intelligence and emotional intelligence both are also working as components to readdress to come out from poverty. Poor people of the country often did not get any sort of banking services. Without banking involvement, they have to depend on informal sector. As such informal sector have been playing vital role in the economy without accountability and transparency. Micro savings ought to come under the operational purview of the micro investment through social networking and Societal banking-based system is required. Otherwise micro savings cannot give good results rather it will have some problems which was raised in Uganda, Rwanda etc. countries. In case of Pareto's optimality criteria of utility theory, Hicks, Kaldor and Scitovsky described that social welfare could be increased without making value judgments. As such Pareto optimality of the people can be attained in line of social welfare so that compensation package can be attained. In the free market economy govt. can intervene at least invisible manner. For poorer people, govt. need to set up some procedure of redistribution, arranging equitable righteousness, removing income inequality and to attain social justice. Social networking is the exercise of intensifying the quantity of one's business and/or social contacts by constructing acquaintances from side to side entities, often through social media along with social

capital, social business and social investment. Social entrepreneurs are the people most able to deliver that innovation (Leadbeater, 1997). Interest rate on lending in the informal sector is very much high in Bangladesh than the formal sector of the country (Ali,2016). Still in Bangladesh informal sector is much larger than formal sector where employment opportunity is very high. In the country, 87 per cent of the labour force is employed in the informal economy according to the labor report on 2010. Those who working in the informal economy include wage labourers, self-employed persons, unpaid family labour, piece-rate workers, and other hired labour. Informal credit market in the absence of regulatory framework is working without any sort of hindrance in the country which needs to bring under supervisory framework. In the country credit is provided by informal lenders who may be friends and relatives, by mahjans who are intermediaries with trade and/or production relationships with ventures, and by traditional money-lenders. The informal market is potentially large and expanding.

Interest rate in the informal market is much higher than formal market and job security as well as obtaining direct taxation form the informal sector is not feasible. As such social networking and Societal Banking may help to convert formal sector. In the informal sector 87.8 percent totally is working while 11.4 percent is working in the formal sector. As per the following data formally employed in multiple job is zero percent. Formally and informally employed in multiple jobs is 0.1 percent in totality basis. Informally employed multiple jobs are totality basis is 0.6 percent. Current banking system of the country has missing services for a larger portion of the people. As such the country needs to develop alternative banking framework at a least cost combination and helping the underprivileged people. Moreover, some NGOs are not working due roles as they are charging higher interest rate which is not feasible for borrowers to repay without cutting welfare and social ignorance. Micro savings need to be encouraged to bring the unprivileged people to the banking system. With the introduction of the electronic banking current commercial banking rate is much higher. Karnani (2007) summarized following problems of microcredit from various studies: Microloans are more beneficial to borrowers living above the poverty line than to borrowers living below the poverty line microcredit; seems to do more harm than good to the poorest; microcredit is the businesses it is intended to fund. Ali (2016) suggested that establishment of integration fund to encourage creative entrepreneurship so that poor downtrodden people can come out with innovative business process through financial inclusion process, to remove poverty. More intensive and pragmatic policy should be developed for the development of the social enterprises particularly for self-motivated entrepreneurs. Experiences from the research work observed that the rural poor are mobilized and working together in self-controlled community-based organizations which ensures social welfare and Pareto optimality. Not only small and medium enterprises but also micro enterprises should get special priority and inclusion through financial organizations are being required for developing proper steps to poverty alleviation, public-private and foreign strategic alliances are required in the small and medium enterprise sector with special emphasis on micro enterprises of the country.

This alternative framework was an attempt to develop a theory on how social networking facilitates to empower people which were developed by Muhammad Mahboob Ali (2016) to test any country. The study will extensively try to display an integral part regarding different dimensions of empowerment before involving in social networking and after involving in social capital, social along with business and social investment along with social intelligence, social enterprises along with micro savings transformed to micro investment. Social intelligence is also one of the key components to readdress to come out from poverty. In Current century a greater role is being played by social media for which interpersonal connectivity in vital.

Environmental scanning for doing the business is vital specially to ease the business process and local economies. Empowerment of people rises from decision making process when people do have purchasing power capability. Societal banking framework should be developed under a regulatory framework may work starting in joint effort of Pali Sanchya bank, Karmasonsthan bank and postal savings deposit and creating investment sector. Societal banking idea is larger than agent banking or mobile banking. It will give the scope of financial inclusion and current 80% people who are working informal sector will gradually transformed to the formal sector. Technological diffusion, innovation, creativity and suitable regulations by the local level planning with local level law are the key to deepening financial inclusion analysis where nano saving must be transformed to nano investment. Societal banking will help to expedite the process of social networking and ultimately empowerment of people. A model as concept developed by Ali (2016) based on aforesaid discussion in this section as Social Networking Model and empowerment of people through transformation of Micro savings to micro investment with the help of Societal Banking.

However, social education in the form of formal or non-formal is very important to act as a complementary. The Rabobank view (2005) described that Rabobank was founded in the Netherlands more than a hundred years ago as a co-operative bank providing access to financial services for small farmers and offering a secure option for savings to the local community. The driving force behind the Rabobank Group has always been to create opportunities for individuals and organizations to participate fully and independently in economic activities. Rabobank has developed an integrated concept of sustainable rural financing in developing countries. In addition, Rabobank participates through its different departments in international platforms and partnerships concerning the challenge of economic development in developing countries. Dupas et al. (2012) depicted that while simply expanding access to banking services will benefit a minority, broader success may be unobtainable unless the quality of services is simultaneously improved. There are also challenges on the demand side, however. More work needs to be done to understand what savings and credit products are best being suited for the majority of rural households. Ngalemwa (2013) described that village Community Banks (VICOBA) have benefited people in reducing their income poverty by playing an important role in enabling the poor to save and access credits. VICOBA lending model is a unique and an effective tool for development of rural communities. Halim et al. (2016) found that the series of income inequality and savings demonstrate a nonlinear relation in Bangladesh. Savings behave differently at different level of income inequality. Moreover, this nonlinear relationship is due to changes in economic policy. From our data set we can see that economic liberalization has improved the inequality situation of our country and caused savings GDP ratio to increase. Ali et al. (2017) commented that policy makers should come forward to think how Societal banking with the applicability of the social networking can be used in local level planning system of the country. They also argued that people must be cautious about misuse of social media as reported by different dailies. Rural savings will be turned to rural investment lead to social entrepreneurship for which we need implementation and help from local level planning. It will be found that in dimensions the people started to become more empowered than before involving in social networking. This may be supported by Technology, innovation and suitable regulations -the key to deepening financial inclusion analysis where nano saving must be transformed to nano investment. Leadbeater (1997) proposed social entrepreneurship can be systematically developed through Societal banking which can act for social welfare. Societal banking will reduce the informal lending at the rural area. Mallick's (2009) observation on Micro Financial Institutes (MFIs) needs to reduce interest rate and his observation for involving in the productive

production process can reduce the interest rate. Social networking and societal banking may be applied for transforming micro savings to micro investment through creating social capital. This will also help to transfer to formal sector from informal sector. Employment opportunity accompanied with economic growth should be raised in the formal sector. This will help to attain equitable growth, social justice and removing income inequality.

If we cannot take the benefits of demographic dividend then it may transform to demographic bomb. Actually, financial inclusion is feasible thorough arranging Societal banking under regulatory measures otherwise it may create a disorder. Macroeconomic stabilization depends on successful implementation of investment and positive return on investment. Situation of the Gini coefficient ought to improve so that social justice and equitable distribution can be arranged and removing income inequality can be attained in the country. Empowerment of people may arrange the aforesaid situation to attain. Systematic procedure and legal status for Societal Banking should be developed which will replace current agent banking system also. To implement sustainable development goal there is no other alternative but to creative alternative banking system in the rural areas so that poor people can not only save but also interested to invest in the local level planning process for which employment can be generated. As such productive investment through social entrepreneurship in the rural areas and changing the structure of the rural economic dynamics is very much important to add value in the domestic and global value chain with efficiency and effectiveness. Social education is also work as an important component to come out from the vicious circle of poverty. PESTEL analysis is for doing the business is needed which stands for Political, Economic, Social, Technological, Environmental and Legal. During Covid-19, when people are suffering from unemployment but government of different countries have declared stimulus packages, if the low-income group have banking account at a low cost then directly government can give them monetary packages directly, if they are unemployed. Covid-19 created pandemic scenario in the world. As such air pollution was decreased as most of the country is following social isolation under pressure from lockdown /shut down or emergency situation. But business processes of different countries have been changed. At the time of Covid-19, China is doing remarkable business.

Other countries if such pandemic situation continues for long time then great stagflation will occur. Those that are not financially included will have to bear the devastating effect as they are unbanked. In that case, if God forbids great stagflation starts, other nations will face the problem and as China did well for temporarily. When other nations will fall victim then China cannot no longer sustain in the production process. As such environment is very much important for economic development. Govt. of Bangladesh tried to open accounts for RMG labors payment which is a good sign to include them in the banking sector. But recently Janata bank, Bangla Motor Branch cut Tk.58 against the salary account on 4th May, 2020 which was actually due to pandemic situation salary was delayed while the bank which was clearing bank cut only Taka 10. As such heavy charges by the nationalized bank are not acceptable and create hindrance of the financial inclusion especially govt.'s good intention to introduce mobile banking for poor personnel. Similarly, in case of agent banking, it is the source of flight of capital from the rural areas to the urban areas. They do not normally invest in the rural areas. Banks mostly act for the defaulters not for masses; Capital market is only active in share market which is largely dominated by the banks. But .to saves these share markets crore of Taka was pumped without any fruitful results. There is a govt. directive that all charges should not be deducted during the pandemic situation, but who cares in the banking sector of the commercial banks? Mobile sim operators need to be ethical and moral as they did some fraudulent activities. As such if mobile banking needs to spread

out transparency, accountability and fairness of the mobile sim operators need to be established. Otherwise there is every possibility of fraudulent activities through the mobile banking and their charge is much higher than that of India. Each customer should need to get statement of the mobile sim operators charge deduction for transparencies. As agent banking and sub banking both do not work for the banking sector as whole, so to make successful societal banking need to be started in the country. This will help for financial inclusion in real terms among all the groups like formal, semi-formal and informal sector. There must be a bridge between micro saving and micro investment where societal bank can act as a successful intermediary. This will also help for local level planning, stop flight of capital from periphery to the centre and help for import substitution development procedure.

CLIMATE CHANGE EDUCATION AND AWARENESS IN INDIA

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Abstract:

Climate change needs a global response through education, where it is an essential element which has global action towards climate change. Education has become an important tool for its empowerment, the information and motivation given for the wide community and government has to plan necessary steps on climate change. Climate literacy increases among young people, by the impact of global warning and it also encourages young people to change their attitude and behaviour towards climate change. Climate change education helps young people to adapt towards climate change in the environment. Climate change plays an important role in increasing adaptation and mitigation capacities of communities through education and awareness program. Climate change education includes curriculum, community and technology-based approaches. CCE which help to increase the climate change response and helps to understand the causes and consequences of climate change. Education helps them to prepare, the knowledge about impacts of climate change and it empowers people to adopt in sustainable lifestyles. Climate change education builds societies with flexible, creative, adaptable, well-informed and inventive sustainable communities. In India, Centre for environment education (CEE) is a programme which spreads awareness related to the sustainability in environment and climate change. Centre for Environment Education has 2 lakh schools in India with 15 languages and which helps to spread awareness and educate people about climate change. This article helps us to understand the climate change education and awareness in India. Addressing climate change requires a understanding, thinking, decision making and coordinated action at national and global level. This paper addresses the education of climate change and awareness in India. This article explains about the policy uptake of the climate change. From the current practices, we have to change significantly to adapt and mitigate the climate changes.

Keywords: Climate change, Education, Awareness, Communities, Climate change education, Empower, Centre for Environment Education.

1. Introduction:

Climate change has causes and consequences in global environment and it is a borderless and intergenerational phenomenon, which helps to diverse the impacts across the local, state, and national around the world. Climate change has certain challenges in food production, water supply, health coastal settlements, forest ecosystems, security and energy. Human activities are irreversibly changing the environment, requiring collective and immediate on climate change. Climate change has become a challenge for the global and trying to make more effective environment. It impacts mainly on poor community and it became a governance issue. The issue in developing countries is reducing the vulnerability of their natural and socio-economic systems to the climate change. A new climate change has major impact in dealing with the industrial sector, agriculture and renewable natural resources in India. From the current practices we have to adapt and mitigate according to the climate changes. The best way to address climate change is to mingle with the sustainable environmental development by developing new technologies and we should promote the energy efficiency, renewable energy, forest conservation, water conservation reforestation and. Climate change is no more an environmental concern. The adaptive capacity is low in developing countries due to lagging of education and awareness towards climate change. According to a World Bank Study, nearly half of the population in India stay in severe hot spots climate by 2050, In India, rainfall

pattern changes due to severe water stress. India is one of the world's most vulnerable climate change countries. Centre for environment education in India gives education opportunity to gain knowledge towards climate change and also building public response, support and demand for new policies to climate change and helps to prepare for the impacts of a changing climate. The Climate Change Research Institute (CCRI) is a Registration Society Act established on 1860, it helps to promote environment and climate change awareness and education. The ultimate of goal of CCRI is climate change in sustainable development helps to reduce the accumulation of greenhouse gas (GHG) emissions in the atmosphere and gives a better environment to the society and the people. The climate change research institute spreads awareness among people in India and helps to understand the climate change.

1.1. Objective of the research:

- To understand the Climate change education in India.
- To understand Climate change.
- To generate awareness of climate change.
- To understand policy to uptake climate change.

1.2. Limitation of the research:

- Time limit.
- Data variation and availability.

Understandings of Climate change Education:

Education is a tool for climate change that changes the attitude and behaviour of the wider community people, society, industry and government. Climate change builds resilience and capacity inhuman to adapt to the changing environment. The economic activity changes since from the industrial revolution till now it is growing day by day. Climate change mitigation lowers carbon paper to green revolution to save the environment. Education helps to understand the individualto be climate conscious and to be active in society and they stimulate government into action. Climate change education is preparing people to deal the complex situation of climate change, build resilience and enhance innovation, mitigation and adaptation in climate change. Recent events have increased our growing vulnerability of climate change. Education helps to shape the skills and knowledge. Impact of Climate affects agriculture, food security, to sea-level rise, natural disasters, species extinction and spread of vector-borne diseases. Education of Climate change and awareness of climate change helps people to prevent the impact of climate change. Youth play a main role in combating climate change and plays a stress role. Youth should have knowledge of local, national and global levels of climate change. Youth education represents one of the important tools to combat the destructive potential of climate change. It is essential to conduct more awareness program about climate change and the role of youth in combating climate change.

3. Climate Change adaption and mitigation:

The strategies to address climate change are mitigation and adaptation of climate change. Mitigation stabilises and reduces the amount of GHGs in the atmosphere and provides risk free environment. Mitigation measures the GHG emissions or move carbon out of the atmosphere. Climate change mitigation ranges from investment in clean energies to forest conservation. Mitigation is the term deals with moving out carbon from globe. Adaptation reduces the vulnerability of natural and humans to impact of climate change. Climate change needs adoption in social, ecological or economic system. Adaptation is the response to actual or expected climate that moderates harm beneficial opportunities and ability of people and systems to adjust the climate change. In natural systems, adaptation is reactive and implemented by public and private actors. Conceptualisation of adaptation is the notion of vulnerability and resilience. Climate change adaptation and mitigation policies covering climate modelling and

assessment of climate change risk, exposure and vulnerability, low carbon roadmap, disaster risk reduction, designing MRV tools; Nationally Appropriate Mitigation Actions (NAMA), feasibility assessment of adaptation and mitigation measures are cost benefits, gender, environmental and social safeguard valuation.

Government of India has given some principles for addressing climate change mitigation. The action plan has eight national missions for emission mitigation within the different sectors. The missions are:

- National Solar Mission(mitigation focus)
- National Water Mission(adaptation focus)
- National Mission on Enhanced Energy Efficiency (mitigation focus)
- National Mission on Sustainable Habitat (mitigation and adaptation focus)
- National Mission on Sustainable Agriculture (adaptation focus)
- National Mission on Sustainable Himalayan Eco-systems (adaptation focus)
- National Mission on Strategic Knowledge Management (mitigation and adaptation focus)
- National Mission for a Green India (mitigation and adaptation focus)

4. Policy to uptake climate change:

Climate change education has relationship between the climate change and the economy. The role of policymakers in ensuring that education plays a major role to address climate change. The cross-sector policies are integrated education and gives opportunities to stimulate awareness of climate change.

- Governments address climate change and it use a multi sectorial to develop policy.
- Climate change education and effective integration requires an understanding of the root causes and the social, economic and environmental relationships.
- Climate change is addressed through the formal, non-formal and informal education targeting a wide cross-section.
- Climate change education should be the main role to develop a workforce with the skills, decision making and knowledge.
- Climate change education should be the curriculum-based approaches.
- Climate Change requires problem-solving and evidence-based thinking skills.
- Collaborative approach in teaching helps to foster acceptance of new methodologies of climate education across the system.

5. Awareness of climate change:

To implement the following actions must be taken by climate change education, awareness and training stakeholders:

- Develop education and create awareness on climate change and sustainable living for schools/public/stakeholders.
- Empower the educators and mentors to share their knowledge, values and experience with different target audiences and help to provide training for teachers, lecturers and environmental representatives in schools.
- Sensitise policy makers address change in climate.
- Integrate climate change education helps all sectorial policies and strategies such as Energy Policy, Agriculture Policy, Education Policy, etc.
- Create a mechanism for information sharing and networking focusing of the role of the education and awareness.
- Provide opportunities for training in climate change and media.
- Seeking fund from different sources

locally and internationally to support environmental education, awareness and training programmes.

- Create opportunities for young people to learn more about climate change in the education.

6. Conclusion:

Thus, this paper provides an overview of Climate change education and awareness in India. Climate change is a key factor understands adoption and mitigation. Climate change has causes and consequences in global environment. It is a borderless and intergenerational phenomenon, with helps to diverse and far-reaching impacts across the global community. Climate change plays an important role in global environmental challenges such as food production, water supply, health coastal settlements, forest ecosystems, security and energy. Thus, this paper reveals that climate change education will help people to understand the climate change and adopt towards sustainable environment. According to the current trend youth education towards climate change is more important. Thus, climate change plays a major role in improving the economic growth and development through education and awareness program.

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EDUCATION IS THE PIVOTAL INSTRUMENT FOR COMBATING CLIMATE CHANGE

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INTRODUCTION

According to UNESCO "Education is critical in helping populations understand and address the impacts of climate change, adapt more sustainable lifestyles and develop skills that support different modules of economics as well as to adapt to the impact of climate change". Education is an essential element of the global response to climate change. Education was providing information about climate change and create awareness how to mitigate climate change. Education offers a greater opportunity to combat climate change. It provides children and young people the knowledge and skills to make informed decisions about how to adopt individual lives and ecological, social or economic systems in a changing environment. Climate change is a long-term change in the weather which is a regular symptom in our environment.

According to UNFCC defined climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".
According to IPCC definition of climate change includes change includes change due to natural variability alongside human activity.

According to Australian Government's DCCEE "our climate is changing, largely due to the observed increases in human produced greenhouse gases. Greenhouse gases absorb heat from the sun in the atmospheres and reduce the amount of heat from the sun in the atmosphere and reduce the amount of heat escaping into space. This extra heat has been found to be the primary cause of observed changes in the climate system over the 20th century".

This study "Education is the pivotal instrument for combating climate change" attempts to know about the need and importance for education for climate change, essential of climate change education, aspects of climate change, different statement regarding climate change education, suggestions for education regarding climate change.

NEED AND IMPORTANCE FOR EDUCATION FOR CLIMATE CHANGE

- Education is the essential component of adaptive capacity. Education provides the knowledge and skills needed to make informed decisions on how to adopt individual lives, as well as ecological, social and economic systems in a changing environment.
- Education offers a greater opportunity to reduce disaster risk and combat climate change.
- Climate change education including disaster risk reduction can change human perceptions and patterns of behaviour that reduce the risks and costs of disasters.
- Climate change education should aim not only to encourage public understanding of climate change and climate literacy among students, but also to reorient the entire education system to achieve low-emission and climate-resilient development.
- Education offers a variable opportunity to combat climate change.
- Education plays a vital role in bringing about behavioural change and schools can play an important part by becoming carbon neutral,

energy efficient and reducing their own ecological footprint.

- Climate change education aims to address and develop effective responses to climate change.
- It helps learners understand the causes and consequences of climate change, prepares them to live with the impacts of climate change.
- Empowers learners to take appropriate actions to adopt more sustainable lifestyles.
- It helps policymakers understand the urgency and importance of putting mechanisms into place to combat climate change on a national and global level.
- Communities learn about how climate change will affect them, what they can do to protect themselves from negative consequences and how they can reduce their own climate change.
- It helps increase the resilience of already vulnerable communities who are the most likely to be adversely affected by climate change.
- Education for sustainable development is an interdisciplinary learning methodology covering the integrates social, economic and environmental aspects of formal and informal curriculum.
- Education is an essential element of the global response to climate change. It helps people understand and address the impact of global warming, increase climate literacy among young people, encourages changes in their attitudes and behavior and helps them adopt to climate change related trends.
- Education and awareness rising enable informed decision making, play an essential role in increasing adaptation and mitigation capabilities of communities and empower women and men to adopt sustainable lifestyles.
- Equipping people with knowledge, skills and values to cope with climate change and ensuring safe inclusive and eco-friendly learning environment are a vital part of facing the challenge of sustainable development.

ESSENTIALS OF CLIMATE CHANGE EDUCATION

- Climate change is socially constructed; each person with their own perspective.
- The eco-social perspective should serve as a foundation for all learning and educative practices.
- The global perspective: existing connections between individuals and community and climate change should be identified.
- Climate change education should be subjective.
- Reflecting with intuition can connect to human needs, desires and wishes, values and identities.
- Art-based learning.
- Dialogical learning.

ASPECTS OF CLIMATE CHANGE

- Global warming-GHG concentration-Emission of greenhouse gases through industrialization, travelling.
- Change in world temperature-GHG concentration along with some other issues leads to warming the word.
- Ozone layer depletion- A slow, steady decline of about 4% per decade in the total volume of ozone in Earth's stratosphere. Which is likely to bring health implications (different cancerous diseases), augmenting extreme weather events (desertification, drought) through opening the curtain that was protecting earth from hazardous sun rays.
- Shrinking ice sheets- Greenland lost 150kms to 250km of ice per year between 2002 and 2006
- Rise in sea level-Global sea level rose about 17cm in the last century.
- Ocean Acidification-CO2 content of the earth's oceans has been increasing

and it is currently increasing about 2 billion tons per year which has increased ocean

- Acidity by about 30%.
- Warming Oceans-With the top 700m of ocean showing warming of 0.16.
- Increased Heat waves
- Flooding
- Droughts
- Intense tropical cyclones
- Loss of biodiversity

DIFFERENT STATEMENT REGARDING CLIMATE CHANGE EDUCATION

UNESCO

Education is first priority in UNESCO because education is the basic human right and the foundation on which to build peace and drive sustainable development. UNESCO promotes climate change education through ESD. Through this concept learners understand the causes and consequences of climate change, prepare lives with its impacts and empower them to adopt more sustainable lifestyles.

- Climate change is a thematic focus across all priority action areas of the Global Action Programme (GAP) on ESD.
- Co-ordinates and implements the Global Action Programme (GAP).
- Fosters efforts to make education a more central part of the international response to climate change.
- Facilitates dialogue and exchange of experiences on climate change education through international expert meetings.
- Supports countries to integrate climate change education into their school systems through capacity building and a whole-school approach.
- Mobilizes schools for climate action through its associated schools' network (ASP net).
- Offers free access to educational resources online and develops technical guidance materials and teaching and learning resources.
- Raises awareness and promote good practices through its GAP.

ACCORDING TO STERN REPORT-

Highlights the importance of education in addressing climate change. Its conclusions focus around three broad themes: carbon pricing, technological innovation and behavior change. Higher education plays a key role in developing and sharing technological advances, school and community education in behavioral change.

2010 WORLD BANK STUDY

"Educating young women may be one of the best climate change disaster prevention investments in addition to high social rates of return in overall sustainable development".

Economists, Wheel development and Hammer Agree "Female education is cheaper and provides larger impacts on carbon emissions abatement than direct low-carbon energy options".

MUTTARAK AND LUTZ

Public investment through education can have a positive externality in reducing vulnerability and strengthening adaptive capacity amidst the challenges of a changing climate.

LORD STERN

"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 action now".

ACCORDING TO WORLD BANK REPORT

Warning climate change could push more than 100 million additional people back into poverty by 2030 it is timely that the new global goals put education in the frontline for both protecting the livelihoods of future generations while addressing the poverty challenge of today. While climate change presents significant challenges to education-education also provides a powerful means

through which to respond.

INTERNATIONAL SCIENTIFIC COMMUNITY

With the international scientific community 95% certain that human activity is driving global warming (IPCC 2014), SDG 4.7 which states "by 2030 ensure all learners acquire knowledge and skills needed to promote sustainable development" is of critical significance. Education is tasked with equipping upcoming generations for the inevitable changes of a+20c world (adaptation) while inculcating a greater understanding of and responsibility for the environmental consequences of human actions (mitigation).

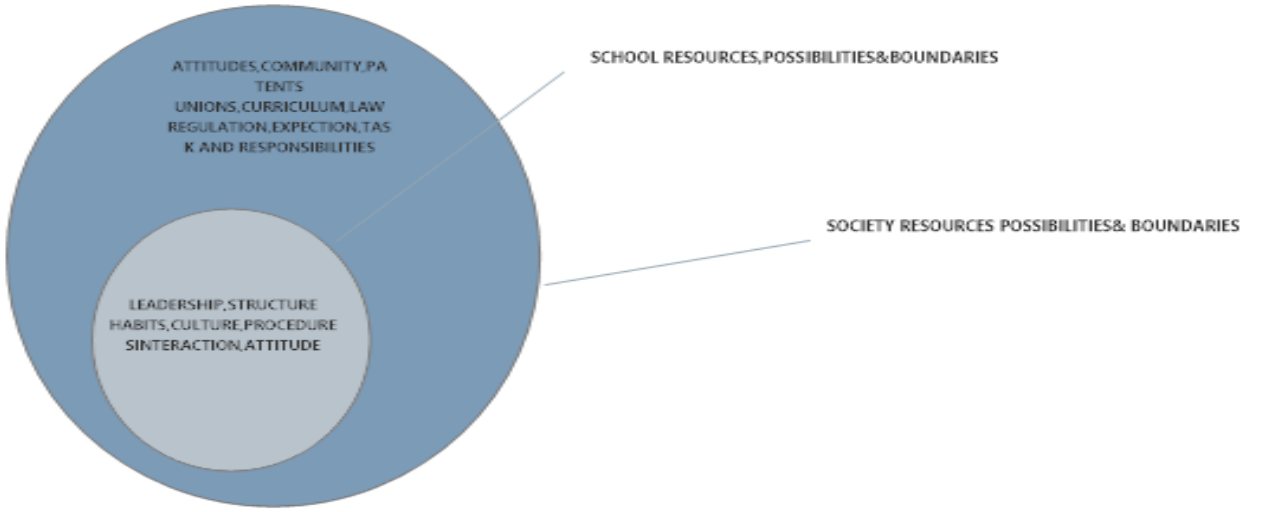
THE ECO-SOCIAL APPROACH TO EDUCATION

According to Salonen and Konkka (2015), Society cannot be established only for meeting the short-term requirements. If natural resources, ecosystem services, and human beings are the only instruments for market growth, our debt to future generations will grow, and our ethics will be determined. Thus there is a hierarchy between ecological, social and economic elements of human well-being. It forms a science-based framework for human activity.

- The viability of ecosystems and the sustainable use of natural resources determine success and possibilities of society and the economy.
- Implementation of human rights-justice, equality, democracy, cultural, diversity determines success of the economy. Human rights represent intrinsic value and apply under all circumstances.
- Markets are an instrument for achieving well-being, not an end in of themselves.

According to Finnish National Board of Education (2014), the curricular, eco-social principles should direct the development of the working and operational culture of the school. The transformation of value principles; the implementation of eco-social thinking necessitates trust, respect and open, integrative within the school communities

Fig-1. The possibilities and boundaries for school development



Art-based learning

Art has a strong role in the societal and cultural change. For combating climate change, there is an urgent need to artistry, creative potential and emotionally engage every human being in visualizing and acting

out a vision of sustainable well-being. Art can bridge the gap between theory and practice. Art can offer a space and provide means for the critical issues of climate change education through emotional involvement, personal meaning making, critical thinking, active agency and creative visioning.

Creative collaboration's a student-centered process

Collaborative learning is student-centred definition because student perspectives are naturally activated and participant's ideas guide the learning process. Creative collaboration can start from anything, but the teacher needs to set the frame for the working process.

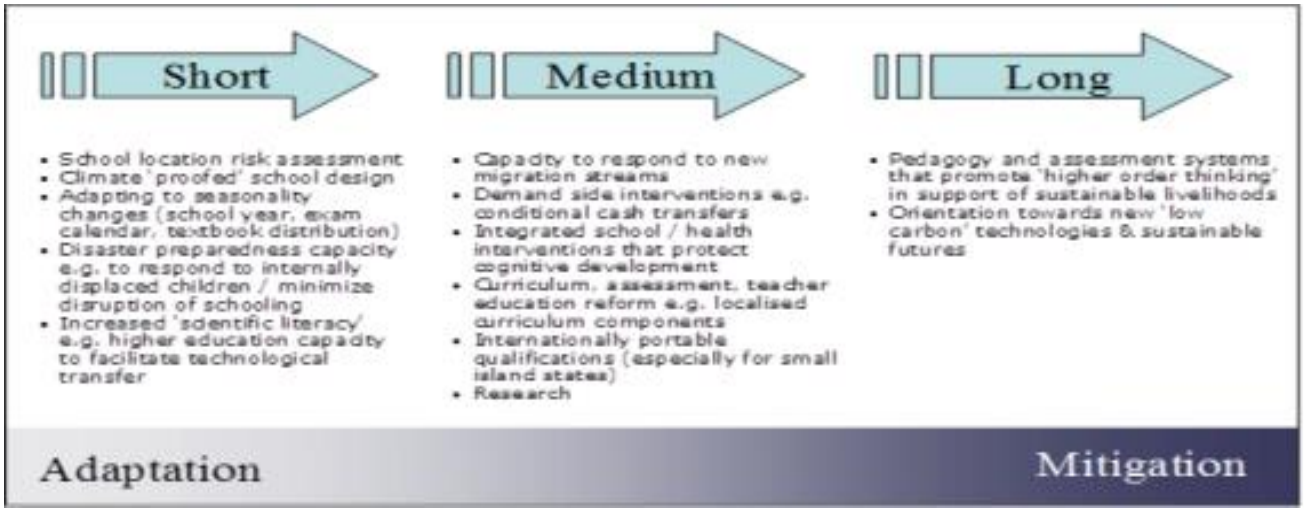
Phenomena-based collaborating learning

Phenomena-based learning has been introduced as an alternative to subject-oriented learning in the new national curriculum. The aim of phenomena-based learning aims that the students build an interdisciplinary, holistic picture of selected phenomena linked to student's communities and interests.

CLIMATE CHANGE EDUCATION IN SCHOOL

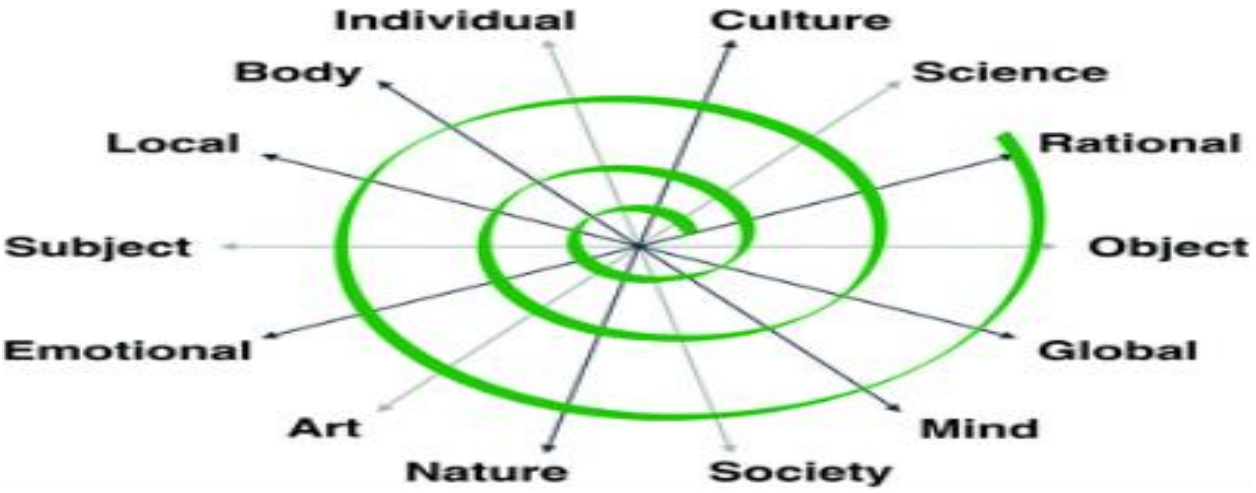
Climate change may be viewed on local, regional and international levels-not to mention through scientific, civic and cultural lenses-provides with the opportunity to develop critical analysis skills and synthesize information. Interdisciplinary education requires more work; it also equips students for the problems and discussions they will face outside of the class room. Through climate change education, schools have an opportunity to teach their students to evaluate a variety of evidence and draw their own conclusions. If students are to leave school and tackle issues head-on they cannot do so without understanding how to use information and balance opposing viewpoints. Teaching about climate change is by no means easy, but it is a challenge with tackling for all those involved-communities, schools, teachers and students alike.

Fig-2 Department for international development Educations role in environmental resilience



Combating Climate Change through quality Education (Allison Anderson, Brookings institution, September, 2010)

Fig-3. Interconnected the aim of climate change education



Interconnected the aim of climate change education (http//media.spingernature.com)

According to a rational system view, it is clear that humans are part of natural systems first, living things second, human beings third, members of society and culture fourth, and particular individuals fifth. Nature and culture should be considered as one, interrelated system. The eco-social perspective helps to understand this interconnectedness and could be applied as the basic principle for all learning and educational practices.

SUGGESTIONS FOR EDUCATION REGARDING CLIMATE CHANGE

- Education provides an important to individual and societal responsibility towards Climate change. So that climate change is a specific subject in every school.
- As long as schools have a responsibility to teach global citizenship and community, they have taught to various dimensions of climate change and how to manage it.
- If schools want to create deep thinking engaged, and self-aware students, they should undoubtedly turn into education regarding climate change.
- Education provides to students an appreciation of the role they play in their environment-both their physical, changing environment and heir civic school environments. So that students are aware about the challenges of climate change.
- If climate change concept included into school curriculum that bring students closer to their communities.
- It is not enough to simply teach students about the science behind climate change; students also need to learn how institutions and individuals deal with problems of this scale.
- Through the education we can aware not only to the students but also the knowledge provide to the community in the society regarding climate change and how to reduce the risk.
- In schools and higher educational institutions various seminars, conferences and workshop should be conduct in short time durations.
- Colleges and universities have taken initiatives regarding climate mitigation.
- Climate change is addressed through the use of formal and informal education targeting a wide cross-section of stakeholders, including as students, communities, industries and governments.

CONCLUSION

Education is taking vital role to aware about the climate change and how to mitigate. From school to higher education climate change education should be introduced so that the students can know about the reason

behind climate change and how to handle those particular challenges. Time to time government can take initiative for creates awareness among people. Higher education plays important role in developing and sharing technological advances and school and community education in behavioural change. Educating the present and future generations about climate change, and teaching them to act with a critical mind is essential for the future humanity. It is essential to develop a portfolio or mix of strategies that includes mitigation, adaption, technological development and research. Through a number of initiatives, such as curriculum changes that include interdisciplinary, professional, training sessions, distance learning etc.

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EDUCATION AND CLIMATE CHANGE: INTER-RELATED TOWARDS DEVELOPMENT

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Climate change presents a borderless and intergenerational phenomenon, with diverse and far-reaching impacts across the global community. Human activities are irreversibly changing the environment in which society exists, requiring collective, immediate and profound action on climate change.

Climate change poses a serious threat to efforts to reduce global poverty. According to the United Nations International Panel on Climate Change, the changing climate will have widespread effects on human life and ecosystems. It brings heat waves, flooding, droughts, intense tropical cyclones, rising sea levels, and damages biodiversity.

Climate change is not just a scientific phenomenon. It is a complex socio-scientific issue that demands more than the teaching of content. Stated in another way, climate change education demands learning that is inquiry-based, reflexive, creative and participatory in supporting learners to develop competencies that are transferable to new, uncertain and as yet unknown, or poorly defined, situations.

Vulnerable groups like children living in poverty in countries with weak governance and poor education systems are the hardest hit by climate change. The changing climate is making it harder for children to access education in a safe environment as disasters caused by climate change can damage or destroy schools. And the economic impacts of disasters reduce school enrolment, as children are kept out of school to help their families earn a living.

Education is the most powerful element in preparing societies for the global challenges that climate change brings. It equips individuals, communities and the wider world with the understanding, skills and attitudes to engage in shaping green, low emission and climate-resilient societies. Education is also 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.

The power of education in climate change responses was acknowledged at the Paris Climate Conference (COP21) in 2015. When delegates from 195 countries drafted the Paris Agreement, Article 12 on education was the first to be agreed upon. The following COPs reiterated the importance of ESD in achieving the global agendas.

An enabling international policy environment

In essence, climate change education is about learning in the face of risk, uncertainty and rapid change. Humans have never before been in the situation now confronting the planet (Intergovernmental Panel on Climate Change 2014).

The important role of education in addressing climate change and sustainable development has been confirmed by several international agreements:

- Article 12 of the Paris Agreement, the outcome document of COP21, stresses that: “Parties shall cooperate in taking measures... to enhance climate change education, training, public awareness, public participation and public access to information...”
- The Sustainable Development Goals

on education (Goal 4) and climate change (Goal 13) recognize the importance of ESD (Education for Sustainable Development) and education's role in climate change responses. Target 4.7 urges that "by 2030 all learners acquire knowledge and skills needed to promote sustainable development..." Target 13.3 calls to "improve education, awareness raising and human and institutional capacity on climate change..."

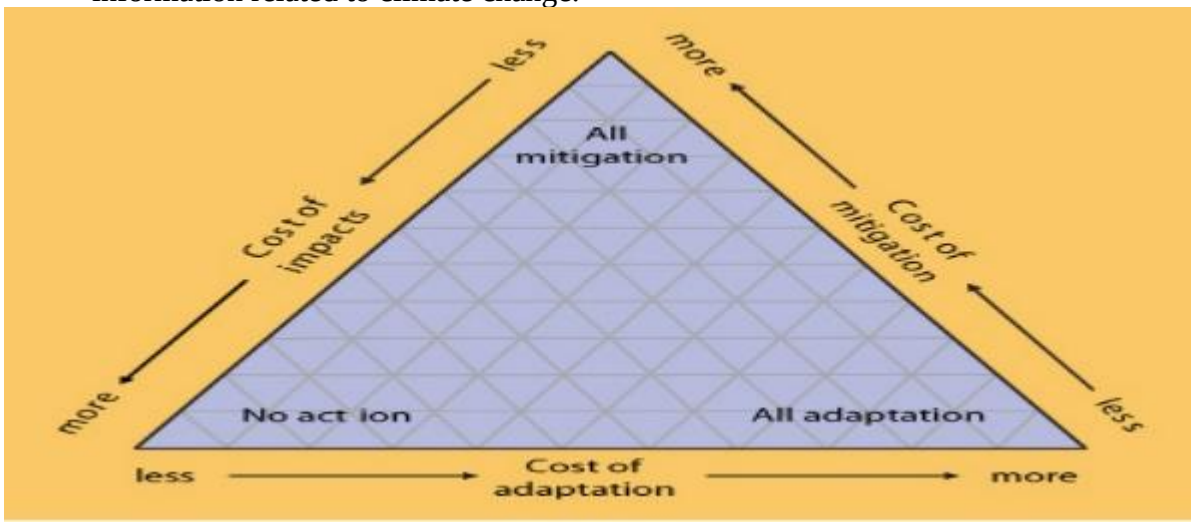
- The Lima Ministerial Declaration on Education and Awareness-raising , adopted at COP20, calls for including climate change in school curricula and development plans.
- The Aichi-Nagoya Declaration on ESD was adopted at the UNESCO World Conference on ESD (2014 in Japan) and reaffirms ESD as a vital means of implementation for sustainable development.
- Article 6 of the UN Framework Convention on Climate Change is dedicated to education, training, public awareness and access to information related to climate change.

Climate mitigation and adaption: an introduction

In general, there are two different strategies when it comes to dealing with climate change. We can try to stop future warming (**mitigation** of climate change) or we can find ways to live in our warming world (**adaptation** to climate change).

- **Adaptation** involves developing ways to protect people and places by reducing their vulnerability to climate impacts. For example, to protect against sea level rise and increased flooding, communities might build seawalls or relocate buildings to higher ground.

- **Mitigation** involves attempts to slow the process of global climate change, usually by lowering the level of greenhouse gases in the atmosphere. Planting trees that absorb CO2 from the air and store it is an example of one such strategy.



Triangle diagram from the IPCC Forth Assessment Report (Chapter 18) describing the relationship between adaptation, mitigation, and inaction. (Image: IPCC AR4)

Humans have a long history of making changes in the way they live to survive environmental changes. We are pretty industrious. These changes are ways to adapt to new conditions. Adaptation of human societies to climate change is taking place today on a limited basis. Current climate change poses challenges to adaptation.

Adaptation happens in a variety of ways.

Some adaptations are fuelled by changes in government policies. Other adaptations occur because of technological advances. (And there are, of course, ways that we individually adapt (insulating the attic to keep cool during summer heat waves or raising and reinforcing a house in a hurricane-prone area).

Advances in climate modelling have provided scenarios of future impacts, which are driving some of adaptation efforts that will hopefully reduce vulnerability to climate change. However, the ability to adapt is not equal between all people, states the IPCC (Working Group II). For example, developing nations with limited resources that are already dealing with the stresses of violent conflicts or high HIV/AIDS rates are less able to adapt to climate change. This is especially problematic in places like southern Africa where the impacts of climate change on drought conditions are expected to become increasingly severe.

There are limits to how much we can adapt. There are often technological and financial limits that prevent the scale of adaptation that we would need. And often people are unwilling to change their behaviours. Plus, while humans may have the ability to adapt to climate change, many other species may not.

There are two ways to stop increasing the amount of greenhouse gases in the atmosphere. You can stop putting so many greenhouse gases into the atmosphere. You can also invent ways to get greenhouse gases out of the atmosphere – for example, planting trees that absorb CO2 from the air is an example of one such strategy. These two methods are usually thought of in combination.

Reduction of the amount of greenhouse gases put into the atmosphere (i.e., greenhouse gas emissions) is usually accomplished through reducing energy use and switching to energy sources that don't release greenhouse gases. Frequently discussed energy conservation methods include increasing the fuel efficiency of vehicles, making individual lifestyle changes, and changing business practices. Technologies such as hydrogen fuel cells, solar power, tidal energy, geothermal power, and wind power, along with the use of carbon sinks, carbon credits, and taxation, are aimed at countering greenhouse gas emissions more directly.

Role of Education for mitigating climate change

Climate change education explores mitigation and adaptation at both the local and global level (Kagawa and Selby 2010) and the interrelationships between these levels. While individual actions are an important part of a holistic response to climate change, some warn against educational responses that end with simplistic or one-off individual actions (Robottom and Hart 1995). This focus on individual behaviour change approaches is contested by those who argue climate change is a systemic problem and therefore requires education that challenges normative values that shape our worlds (Gonzalez-Guardiano and Meira-Cartea 2010).

Transitioning from unsustainable values and, practices such as carbon-dependent forms of transportation, requires students to assume responsibility and develop the capacity to become civically engaged in collective actions that can contribute to reducing greenhouse emissions and transforming communities and societies to enact more sustainable policies and structures.

Scientists and engineers engaged in all aspects of climate change have a critical role to play in advancing and implementing climate change education as they have the knowledge that must be embedded in curricula and conveyed to teachers. Cognitive scientists and education specialists also have a role to play in advancing climate change education, bringing to the table their understanding of the learning process at all ages, effective pedagogy, and the design of robust and effective teaching materials. These groups need to support the creation of

teaching resources and professional development opportunities required for teachers at all levels.

Further, scientists and engineers must speak out about the necessity of such education, both globally and within their own countries and communities, as essential advocates for the importance of climate change education, the critical role of teachers, and the required resources. For example, new multilingual initiatives may include a global service providing resources and tools to teachers; local services may create direct web-assisted interactions between scientists and teachers.

Education on climate change will inculcate a new spirit of enquiry in the fields of science and economics, with the vision of creating a sustainable planet. Education is the backbone of innovation. Transportation is a key impact area. Cars must use renewable energy sources. Sustained awareness campaigns will encourage people to think about the planet over profit and convenience. They will prefer using public transport, car-pooling and bicycles. Once 'Right to Healthy Living' and safeguarding the planet for future generations becomes the demand of the people, governments will no longer be able to ignore the issue. Serious re-education of governments about the dangers of climate change on our planet will play a vital role in mitigating climate change and ensuring swift adaptation to sustainable methods of life and economic growth.

Conclusion

The world has already produced enough plastic to last another millennium. Yet, virgin plastic continues to be produced while 8 million tonnes of single-use plastic are dumped in oceans every year. Marine life is dying and our planet is negatively impacted with rising global warming. We need to stop this decline now. Change in global climate patterns is attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels that are also the root cause of the plastics and waste management problem. Education will play a huge role in changing mind-sets and how we approach the solution.

Education here does not refer only to formal systems but also the informal spread of learning through various platforms. Education that is not just limited to schools, colleges and other such establishments, but information sharing on a global scale that will provide knowledge and skills and bring about behavioural changes leading to responsible, sustainable production and consumption patterns that will positively impact society at large.

ROLE OF AGRICULTURAL EDUCATION IN UNDERSTANDING CLIMATE CHANGE

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Introduction

The climate represents three major surface variables namely temperature, precipitation and wind which influences all the sectors of growth and more crucially agriculture. The climate change is conceptualized as change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1992). The Intergovernmental Panel on Climate Change (IPCC), a United Nations body for assessing the science related to climate change, cautioned that the mean global temperature would rise by 1.5°C to 2.0°C in the year 2100. Consequently, a global warming would escalate climate related risks on health, livelihood-food security, supply of water and economic growth unless and otherwise concrete efforts are taken to minimize its adverse impact. It is estimated that due to rise in temperature vis-à-vis rising sea level, around 200 million in the world might live below the sea level line and additionally 160 million people will be affected by higher annual flooding due to rising sea levels (Buchholz, 2020). In the perspective of development, climate change is recognized as risk multiplier and could burden the poorest and most vulnerable sections (Sami et al. 2016).

Among three major sectors of growth viz., agriculture, manufacturing and services, agricultural sector is predominant in most of the developing countries because the crops grown in these regions constitute a major share in land area globally and secondly this sector feeds huge population which is also concentrated in these regions. Among developing countries, India is an agricultural dependent country with huge population. The country is also subject to vulnerability due to climate change (Cruz et.al.). Consequently, droughts, floods etc. are occurring more frequently than before. Therefore, education on climate change is vital for the society in order to understand the impact and to learn how to adapt effectively in the years to come. Besides, the educators would play a major role in educating the student fraternity and the society to understand the various challenges posed due to adverse effect of climate change and suggest possible solutions to mitigate its impact. This paper discusses how education, especially agricultural education, could pave way for better understanding about climate changes, more particularly, in measuring the impact of climate change on agriculture and thus suggest how the educational institutes providing agricultural education could play a leadership role in achieving the goals contemplated by the country for better health and livelihood security.

Sustainable Development Goals and Educating climate change

In order to achieve a better and sustainable future for the entire world, a blue print was prepared with 17 goals termed as Sustainable Development Goals (SDGs). Set in by the United Nations Assembly on 27th September, 2015, the countries across the world are committed to achieve these goals by 2030.

The Sustainable Development Goals are:

1 No Poverty	**2** Zero Hunger	**3** Good Health and Well-being	**4** Quality Education
5 Gender Equality	**6** Clean Water and Sanitation	**7** Affordable and Clean Energy	**8** Decent Work and Economic Growth
9 Industry, Innovation, and Infrastructure	**10** Reducing Inequality	**11** Sustainable Cities and Communities	**12** Responsible Consumption and Production
13 Climate Action	14 Life Below Water	**15** Life On Land	**16** Peace, Justice, and Strong Institutions
17 Partnerships for the Goals			

Source: Opportunities and options for integrating climate change adaptation with the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction 2015–2030, United Nations Climate Change Secretariat, Bonn, Germany 2017

The above 17 Goals are intertwined and each goal is framed with several associated targets to be achieved, the progress is tracked with measurable indicators and is closely monitored. Among the 17 goals, Climate Action (SDG Number 13) is very relevant in the context of this paper. The buzzword in the Climate Action is "Take Urgent Action to Combat Climate Change and its Impacts" (UNDP). The Goal 13 also suggested to strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries, integrate climate change measures into national policies, strategies and planning. In the agenda with regard to creating sufficient knowledge about the climate change and its likely impact on humans, the Goal 13 suggested to raise awareness, enhance the human and institutional capacity on climate change, mitigation, adaptation, impact reduction and early warning. It is also felt that technologies essential for understanding climate change and its action should be carried out such that the capacities for putting them to use must be enhanced (Yohe et.al. 2007; United Nations, 2019)

The United Nations Member States also foresee that the educational institutes and the educators need to impart sufficient knowledge about climate change and its resilience. The major learning objectives contemplated are categorized into three namely cognitive learning objectives, socio-emotional learning objectives, and behavioral learning objectives.

In the context of cognitive learning, the educators help their clients to clearly understand greenhouse gases and their effect on climate change, consider climate change as an anthropogenic phenomenon, identify nature of human activities contributing climate change, ecological, social, cultural and economic consequences of climate change, ways and means of prevention, mitigation and adaptation strategies at different levels namely global, national, local and individual. The socio-emotional learning objectives vouch that there is clarity in understanding of ecosystem dynamics, required collaboration with others to deal with climate change and encourage others to protect the climate. Lastly, the behavior learning objectives must ensure that the learners are able to evaluate activities that are climate friendly, act in favor of people who are adversely affected by climate change and are to be able to promote policies addressing climate protection and support climate friendly economic activities.

Impact of climate change on Agriculture

The most cited factors that influence climate changes are temperature, rainfall and the greenhouse gases (CHG: CO_2, methane and nitrous oxide). However, determining how these factors would negatively impact the globe, more specifically on agriculture, is much more complex. In a way agriculture is also responsible for causing such adverse impacts due to climate change. It is estimated that about 17 percent of greenhouse gases are emitted through agricultural activities and additionally 7 to 14 percent are emitted due to changes in land usage. Moreover, methane gas is released by ruminant animals and nitrous oxide is emitted to atmosphere from soils, fertilizers, manure and livestock (OECD, 2016). Nevertheless, agriculture could also offer solution to mitigate such impacts. The field crops, for instance, emit greenhouse gases that affect climate but at the same time also absorb them **(**Doll and Baranski, 2011). The magnitude of release of such gases and absorption further depends on the cropping or farming system practiced in a particular region. Thus, the effect of climate change on agriculture would differ across the regions in any country.

In India, agriculture is highly diversified with varying cropping or farming systems. Besides, India has one of the highest rainfall zones in the world (Cherrapunjee) and in another part of the region the country has one of the largest deserts in the world (Thar Desert). Thus, Indian agriculture is operated with diversified farm due to differences in soil type, size of farm, date of sowing and harvest, nature of crop selection and its production techniques, source of irrigation etc.

Several studies are conducted to assess the impact of climate change on agriculture. Most of the studies indicated that the climate change would induce a decline in productivity of crops. The climate change not only reduces yields in major food crops like rice and wheat (Senapati et.al.,2007; Raymond, 2009) but also affects the flora, fauna and population dynamics of insect pests and diseases (Karuppaiah and Sujayanad, 2012; Aydinalp and Cresser, 2008), soil productivity and socio-economic aspects (Shakeel Khan et.al, 2009). The global warming could also induce more migration from rural to urban areas, effect large monsoon variability, a decrease in number of rainy days, more flooding and resource conflict among the stakeholders. On food front, the global warming may lead to economic losses and decline in general consumption levels, especially among poor. Accordingly, it is the responsibility of each and every country to understand the magnitude that the climate change likely impact and need to frame policies to adapt themselves to such changes. A clear understanding and further educating the farmers and other clientele groups on climate change adaptation would no doubt enable each country to achieve sustainability in agriculture.

Agricultural Education in the context of climate change

Generally, education when delivered is perceived as one of the means of improving knowledge, way of living, and socio-economic status of an individual. Its purpose is not to produce mere “literates” but to develop a “learning society”. Moreover, teaching and learning about climate change is challenging (Shepardson et al, 2011). Thus, in the context of occurrence of global warming and climate change, the higher educational institutes play a crucial role in executing a leadership role in meeting the challenges and thus motivate the society to adapt themselves to changing scenarios. The educators thus take the responsibility of teaching the subject matter of global warming vis-à-vis climate change not only intensively but also enable the learners to think critically.

Higher education in agriculture and its related subject matter namely agricultural resource management, meteorology, remote sensing, agricultural residue recycling, environmental sciences etc. are well placed

in the curriculum to understand and contribute to adapt suitably to the changing scenarios (Chakeredza et.al. 2009). Agricultural education is designed such that the other disciplines like natural and social sciences are blended. This brings lot of strengths to the overall agricultural education curriculum and makes the higher educational institutes to build the capacity to respond to any complex issues like sustainable rural development (Chittoor and Mishra, 2012), food and energy security (Engler and Kretzer, 2014), natural resource management, environmental safety etc.

In India, under National Agricultural Research and Education System (NARS), currently there are 63 State Agricultural Universities (SAUs), 4 Deemed-to-be Universities (DUs), 4 Central Universities (CUs) with Agricultural Faculty and 3 Central Agricultural Universities (CAUs) to provide higher education in the field of agriculture and allied subjects (ICAR, 2018). These Higher Agricultural Educational Institutes, (HAEI) are reorienting their curricula and strengthening the agricultural education system in India. Besides, with the changing agricultural scenario, agricultural education addresses the dynamic needs of the society with some of the frontier sciences. Within this framework, any science based learning through STEM (Science, Technology, Engineering, Mathematic) needs to be reinforced with STEAM by incorporating "agriculture" (A) in the STEM (ICAR; NRC, 2009). Agricultural Universities are also structuring their subject matter to play a major role in understanding climate variability and its adaptation strategies.

Conclusion

Climate change is posing a great challenge to mankind. The major consequences of climate change are general rise in temperature, rise in sea level, unprecedented floods, drought etc. which affect all sectors of growth in any country. The schools and higher educational institutes have to play a major in creating awareness among younger generation about the ill effects of global warming and the educators need to deliver the necessary skills and knowledge in such way that the students and the overall society would be able to tackle these challenges. One of the major challenges due to global warming is sustaining food production vis-à-vis the livelihood security of the world population especially people living in developing and least developed countries. Agricultural education is prime key in rural development. Its role in mitigating the adverse impact of climate change has no doubt profound implications for agricultural educational institutions. Thus, if agricultural education wants to play a leadership role in understanding climate change, the educational institutes imparting such education need to work more rigorously with curricular content and pedagogical methods in such a way that their student-clientele groups are provided with adequate learning resources and capacitate them to meet the future challenges.

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COMBAT CLIMATE CHANGE: AN EDUCATOR'S PERSPECTIVES

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Introduction

Climate change has become a major threat globally. This has affected major countries throughout the world. It is important to for people know about climate change. Climate change refers to the long-term change in the global climate. This is connected to Global warming. Global warming refers to the slow increase in the earth temperature, which has been caused due to the more heat striking the surface of the earth. Because of this overheat the ice in Antarctica melts leading to rise in sea levels. This further leads to increase in sea levels, bringing all the land under the sea. As so much process is involved in nature due to global warming, it is sad to say to that there is no proper awareness and knowledge among the public regarding climate change. According to the latest ARS report on climate change, it warns that this particular issue might lead and pave way to several problems like water shortage, no food security, major lands going to be taken away by the sea as the sea level rises, more environmental diseases etc. it is also important to know that countries near the coastal regions are the badly affected ones, as they are the one's going to go under the sea first, eg. Jakarta in Indonesia. Not only Indonesia is affected, countries like China, India are the ones' that are badly affected. Now how to come out of this problem?

Among of the various ways available, to come out of this global warming problem, Education is one of the tools through which we can combat climate change. In education, Environmental views and ecological paradigm with its updated version is one of the areas where people can be provided awareness. It is important for humans to know about the existing relationship between nature and mankind. When nature is spoiled by man, nature goes unbalanced and it gives catastrophic changes. Hence good identified and observed behaviour is one of the important motivators for positive climate change that can be brought and spread among people.

Combating climate change and strategies from Education point of view

According to a study by Xue et al. (2016), highlights eco-centrism (addressing ecological problems) and anthropocentrism (looking into nature with faith and interests) through which climate change can be combated. (Zheng and Wang 2013) stress on the usage of communication on climate change among public.

Another way to combat climate change is through engagement. We have heard about employee engagement in organizations. We call it is public engagement. Very meagre research and studies under this area has been carried out. Public engagement means involving public and through them we can make people realize the further dangers of climate change if we don't combat it now. The public can be in the form of students, teachers, various professionals from different profession or cine artists can be involved. It is important to analyse that public engagement through education, journalists can be dramatic change among public by writing in different journals in the form articles. It is also important to reach common man, where this can be solved through film stars.

The developed countries like US and Saudi Arabia needs to follow proper practices regarding pollution through which the climate change can be combated. The meet on climate change held in 2015 had set high targets where countries have agreed to limit the temperature well below the per-industrial levels. We need to be happy that India has occupied 9th position in Climate Change Performance Index (CCPI) as per the COP25 survey summit.

When countries try to take steps, they are unable to achieve it. It is important that the steps taken for fighting first reaches to the illiterates because it takes a long time for them to understand. For example, farmers belonging to rural communities around the world face this problem specifically to mention in the African countries where the socio-economic conditions of the farmers are very poor compared to other countries farmers' socio-economic conditions. In Africa this climate change has been tagged as "vulnerability hot spot".

Ke Zhou, Xia Cao (2009) in their studies has provided further insights on combat climate change through their research studies. In their studies they discuss carbon emission as one of the main reasons for climate change. They insist on "harmonious but differentiated" strategy in combating this challenge. They further explain that industries need to take proper steps and should channelize and implement proper and safe methods for carbon emission.

Oluwatoyin Dare Kolawole et.al (2014) through their research have insisted on different strategies that be used to combat climate change. They are 1. Enhancing farmers weather knowledge through observation, experimentation and exploration 2. Empowering local communities 3. Bringing all the stake holders of weather and trying to provide solutions to combat this challenge 4. Providing more research contributions relating to weather forecasting 5. Providing indigenous knowledge relating to weather conditions to people etc.

It is been noted that Singapore has been finding and trying new ways in combating climate change. In recent 2019 news there was video which explains that garbage disposal is done in such a way that does not affect the fauna life and carbon emission is converted in to reusable energy. India can try such ways which helps to protect the country as this country is surrounded by oceans on all the three sides. In my opinion like Singapore, a guide or manual can be prepared and circulated in schools and colleges. Conducting dramas, show casing films on the drastic results on climate change will through more light on the issue and to the audience.

UNESCO has also provided its roadmap for 2030 through its report "Changing minds, not the climate the role of education" regarding strategies for climate change. The organization has identified different ways to provide solution to this issue on climate change. The schools can be supported through capacity building programs on climate change. Conducting expert meetings, allowing students to access educational resources, raising awareness and promoting good practices and conducting International conferences along with UN are the few ideas penned down in this report.

Hence it is high time to start implementing the changes and it is the need of the hour to save the human kind.

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IoT AND IIoT FOR ENVIRONMENTAL CHANGE MODERATION WITH A FUTURISTIC SOLUTION

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Abstract

With wars, pollution and multiple risk that is threatening the environment. The population of more than 7.3 billion, the planet suffers from continuous damage from human activity. As a result of these human distortions, global climate change is one among the foremost fatal challenges that face the planet. Climate Change will not be slackened or stopped by an action, nevertheless with the aid of few contributions from other fields, it will have a remarkable impact. Moving to electricity generation, manufacturing, and transportation produce most promotion, although the technology field can also play a significant role. The Internet of Things (IoT) in specific, has the prospective to lessen greenhouse emissions and help reduce the upsurge of global temperatures. IoT contains more than highly magnificent new gadgets and smart widgets. It also stimuluses the Earth's state, from its available resources to its climate. This paper displays that technology could subject as the tool that will save the world, if we take lead of it. Environmental monitoring is a spacious application for the Internet of Things (IoT). These keys are the premier foot to creating a abundant connected infrastructures to boost innovative services, superior flexibility and proficiency.

Keywords: *IoT, climate, environmental, challenges, risks.*

1. Introduction

Climate change characterizes a critical situation for human beings globally. But, the Internet of Things (IoT) proposes numerous resources and variety of tools that help businesses and governments lessen the harmful effect of human activity on Earth. Climate change also fires debates in great part since it motivates people to think in terms of paucity. If they concede the presence of the glitch, they would want to forgo their lavish lifestyles and what they relish to lessen their carbon footprints. Though, these aren't constantly the cases. These reasons are mainly instigating the climate to warm and weather to go wild, which in turn is flooding the atmosphere with carbon dioxide by human race. We produce CO2 when we burn fuels such as petroleum, coal, or natural gas. We therefore want both to befit radically more energy-efficient and to drive carbon out of the electricity generating system, even while using electricity in many ways. For the Future, electricity must be produced with the help of balanced sources such as solar and wind that does not generate CO2. IoT can help in rising the speed, power, and proficiency of consumer goods while still lessening energy consumption.

Until now IoT progressions permitted companies, governments, and consumers to reverse climate change without the aid of forgoing their suitability. It's projected that consumers will contribute in activities that allow businesses and governments to collect Big Data and to study it for the advantage of the environment. Connected devices lay a way to climate change and environmental health terms to be the future. In 2016, Gartner [1] research stated that smart cities globally will use 1.6 billion connected devices. Similarly, current reports by Ericsson states that information and communication technologies (ICT) can benefit cut up to 63.5 Gtonnes of Greenhouse Gas (GHG) emissions by 2030 as displayed in Figure 1. Additionally, given the rising amount of collaborations the IoT makes between different industries, we can see for the first time a concurrent decrease of industries' environmental footprint, gratitude to energy savings and smarter solutions.

Figure 1. ICT reducing global GHG by 2030 (**Source:** Ericsson: ICT and the Low Carbon Economy)

The verity that all those industries and leaders globally have the incentive to rise the implementation of IoT solutions, if they want to keep rising and keep it competitive. This is the reason the Internet of Things may significantly considered as a powerful tool in the contest against climate change, exactly at a time when global leaders promote for more economically feasible and accessible ways to protect our planet. The world soon are going to be consisted of various connected systems which can make it possible to depend far more on variable sources of power like solar and wind. Many experts around the world thought such sustainable sources couldn't comprise more than 10% of total energy production, at best, because of how intermittent they were, but as the potential of the IoT has become clearer, it now appears that the maximum amount as 80% of the world's total energy production could eventually come from renewable. For Example, NRG, the gigantic commercial utility toils really very hard to accomplish aim of lessening its overall carbon emissions 50% by 2030, even as the company demands to persist growing and by 2050 it makes a potential to cut CO2 an remarkable 90%, using emissions of 2014 as a baseline.

Global leaders believe the procedure of facing climate change is highly complexed challenge, but estimation and assessments by communications equipment titan Ericsson and environmental unit Carbon War Room voice that the growth of machine-to-machine communications, or IoT, can get us a decent part of the method there, lessening to nearly as 18% by 2030 [2]. IoT makes way towards the formation of a smart electric system in which there can be humongous flexibility in both supply and demand. Also, a responsive energy network during which both production and usage are often quantified in real time, and correlated by the assistance of IoT smart systems. Power will not got to be produced only it's consumed, because we'll have new ways of predicting demand, usage, and storing energy. So, we could get to the truth proving that all of these massive numbers of connected devices will offer different additional ways to make humans, environment and its energy use more efficient, and reduce carbon production. It's so clear that IoT won't change our lives only but changing the whole planet.

2. Global Risks 2019 Report & Failure of Climate Change Mitigation and Adaptation

The Global Risks report of 2019 in its 14th edition which approximately made by 1,000 of finest decision-makers from both the sectors and civil society portrays the top ten crucial risks faced in the world. Nine out of ten respondents expect that economic and political confrontations will get worse between major powers this year. Over a ten-year, climate-change and weather policy failures are seen because the gravest threats. The present year's report presents a remarkable thorough sequence of "what-if" topics discussing about future and studying many crucial points such as weather manipulation, emotionally responsive artificial intelligence, monetary populism, and other potential risks. On the human causes and effects of global risks chapter the theme of emotions is addressed obviously to call for bigger and more effective actions around rising levels of psychological strain all over the world [3,4].

Table 1. Top 10 Global Risks In 2019

	Top 10 risks in terms of Likelihood	**Top 10 risks in terms of IMPACT**
1	Extreme weather events	Weapons of mass destruction
2	Failure of climate-change mitigation and adaptation	Failure of climate-change mitigation and adaptation
3	Natural disasters	Extreme weather events
4	Data fraud or theft	Water crises
5	Cyber-attacks	Natural disasters
6	Man-made environmental disasters	Biodiversity loss and ecosystem collapse
7	Large-scale involuntary migration	Cyber-attacks
8	Biodiversity loss and ecosystem collapse	Critical information infrastructure breakdown
9	Water crises	Man-made environmental disasters
10	Asset bubbles in a major economy	Spread of infectious diseases

Source: World Economic Forum Global Risks Perception Survey 2018-2019.

In the table above we can see that environmental concerns accounted for three of the top five risks by likelihood and four by impact classification. Watching it precisely we might also see that "Failure of climate change mitigation and adaptation" takes the next position on both impact and likelihood records as shown in Figure 2, mirroring respondents rising concerns about environmental policy failure. Global economy, societal and geopolitical risks are also holding huge concerns with respect to likelihood and effect. By rising the human wants and dependency on technology even more, several new stakes have been summed to the world risks list and the amaze is that cyber-attacks emerges in both top 10s, at 5th spot for likelihood and 7th spot for impact, whereas data fraud is at 4th for likelihood only, exhibiting that the technology is also included to pressurise the world safety and initiate a new issue about global security as it will be shown by the end of this paper.

Past years we have seen massive data breaches, with millions of people's data affected, as well as continued cyber-attacks on both public and private lines of businesses. Around 82% predicted that the danger of cyber-attacks will precede to money theft and data to increase in 2019, with 80% supposing they would interrupt operations.

Under "a momentous decline in the existing quality and quantity of fresh water, causing in injurious effects on human health and-or economic activity" water crises, societal risk was distinct and took an highest priority on both lists. It is at 4th place for impact and 9th for likelihood. The report cautions of the macro-economic dangers the world faces as we head into 2019.Defendants also anticipate risks to grow this year, associated to "economic confrontations between major

powers" (91%) and "erosion of multilateral trading rules and agreements" with percent equals (88%). Financial market precariousness and fast world development through 2018 square measure emphasized by the authors - and so by the recently International fund forecasts. Which results, the jeopardy of connected degree quality boil in major economy is 10th possibly. These risks don't occur in seclusion or on discrete. They are completely unified and each has the probable to affect the others as the following chart from the report studies.

3. IoT Fights Climate Change

A way of accomplishing this mission of opposing climate change is with help of progresses in machine-to-machine communications, or the Internet of Things (IoT), which can have a immense role to as much as an 18% lessening by 2030 [5]. IoT can be well-defined as a grid of objects embedded with numerous numbers of sensors, application, network connectivity and computer ability, that can connect, direct and trade data over the internet and permit smart solutions. Presently, IOT is tendering exclusive opportunities for delivering many ecological concerns like clean water, landfill waste, deforestation, and air pollution and eventually would help lessen the environmental effects of human activities. Because of a survey the market magnitude of IoT will have an immense intensification globally as all top companies trust in the significant role of IoT for human life and the environment as well. Figure 3 signifies a statically study for IoT platform market magnitude from 2017 to 2023. For a better illustration about IoT's efficiency in fighting climate change, next sub-sections will enlighten various life fields that IoT offers as useful keys to be the saviour to the environment and top to solve the issue of climate change.

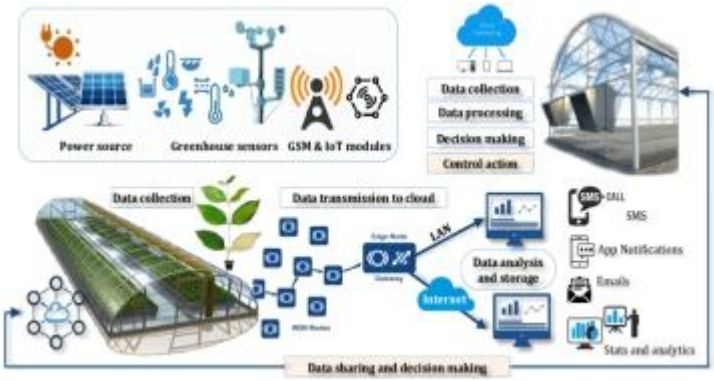

Figure 2. Intersection of Likelihood and Impact classifications of 2019

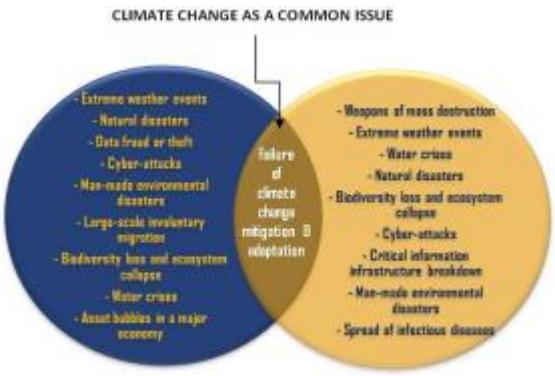

Figure 3. Global smart systems, services and IoT platform market size from 2017 to 2023, by region

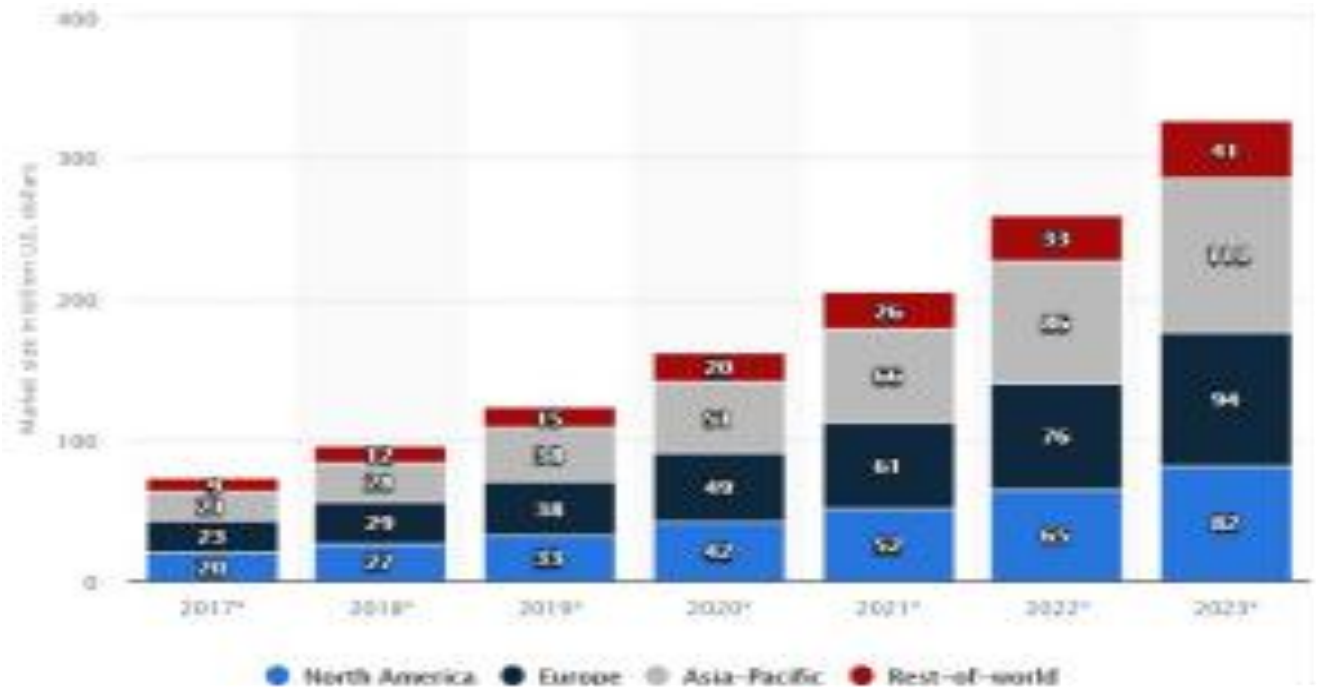

Figure 4. General components of a greenhouse environmental monitoring based in wireless sensor network and IoT concept (**Source:** R Shamshiri)

3.1. Agriculture

Agriculture operations strived many years to lessen their influence on climate change through carbon emissions, as its carbon emissions are few of the prime on the planet. The agricultural part is also the vital therefore, is eyeing to the Internet of Things for paths in which it can notably advance its sustainability through schemes such as smart farming and precision agriculture. Deploying sensors to collect, process and transmit data in agricultural activities will direct to the growth of progressive techniques in meticulous agriculture. IoT devices will also intensify weather forecasting procedures reliably which enables farmers to efficiently use of their resources and decrease wastes. Thus, will progress the living situations of below poverty line and progressing countries, and also reduce the agricultural activities' environmental footprint. The International Telecommunication Union (ITU), observed that the families living in distant rural areas with electricity and internet access is continually growing and this paths to support the opportunity of involving technology in agriculture in various ways which confines the insecticides, fertilizer and water usage to the very minimum, as well as weather forecasting systems. Figure 4 describes the basic mechanisms of a greenhouse environmental monitoring based in WSNs and IoT.

3.2. Energy Storage and Building Automation

Utilization of energy by people is believed to be the prime factor that are increasing climate change because of usage of central heating or power plants producing a huge pollution, such as CO_2 emissions. It must be known that huge portion of energy utilization is not triggered only by our needs, but also by an unproductive management with minute forethought. Actually, we utilize more than needed because of too little data analysis. Observing people energy utilization makes it feasible to lessen wastes. Though an unprogrammed thermostat wastes 20% of heating and cooling, it can be tackled with a smart thermostat that studies patterns and robotically fine-tunes to save energy, Figure 5 comprises many smart thermostats examples. IoT-enabled devices can be automated, observed, and measured by an intelligent energy storage system so that they only work and consume power when needed. IoT saves

energy and carbon footprints with materials which is simple as using an app to put off the lights.

Figure 5. Smart Thermostats (**Source:** bestsmartthermostatreviews.com)

3.3. Climate & Environmental Related Data

Climate models are crucial for the procedure of assessing the global climate change effect, due to the complications of our planet's weather classifications denotes today's top models are yet deficient and additional data is still desired to model the climate and forecast changes precisely. Since IoT concept is immense for producing information, it will be the ideal solution to gather data about climate. There are temperature, humidity and precipitation sensors used globally already, but IoT devices can deliver further strong data from much more sources. These devices can also observe ocean temperatures and sea levels more exactly than earlier, and this data will be totally supportive for mitigating prospective changes initiated by climate change. Meticulously from IoT devices will allow scientists globally to perceive minute variations and fine-tune their models consequently. Since, the ecosystem is always that majority of people are passionate about in a way, there are a humungous number of projects set up with the intention to lessen emissions, pollution, illegal logging, other environmentally damaging and polluting activities. IOT ensures efforts to reduce deforestation, that might account for 15% of global carbon emissions, having sensors appended to trees that heed to sense then report illicit logging. This data is also visualised in real-time and it is trusted these kinds of technologies will allow groups to bargain increased guards for these areas to facilitate combat climate change and deforestation. Below figure presents applications of environmental uses of IoT.

Figure 6. IoT Environmental Applications

3.4. Smart Cities

The usage of associated devices will modify how the civilisation get involved with the environment, particularly in city, where 70% of our classes is projected to survive by 2050, with respect to the latest information of the UN population forecasts. Smart buildings and cities are upcoming in connecting buildings, homes, offices, warehouses, and public infrastructure. Processes such as lighting, power, waste collection, and alarm systems and so on can be connected to centralized management systems that run them as effectively as feasible with respect to lessen energy trash and the edifice's carbon footprint. Using IoT-powered intellectual transportation systems, a smart city today steer you across its roads on a road that best avoids delaying on traffic signals or thickly congested areas. These systems are powered by the data and other associated systems generate and share that is utilized by a central management system in order to make the smart city extremely intelligent. As climate

change turns out to be highly pertinent for everybody on earth, the usage of IoT technologies might all be applied in order to assist fight the consequences of climate change and have any extreme weather or environments to a least.

Figure 7. Smart Cities vision by Ericsson (**Source:** Let's look at some issues of debate in the IoT community. The rise of LPWAN is animating the industry, what does Ericsson think about LPWAN and forms of connectivity in general?)

4. Future is for Industrial Internet of Things (IIOT)

A significant purpose for embracing IIoT by manufacturers, service companies, agriculturists and healthcare contributors is to upsurge production and efficacy through smart and remote management also by being eco-friendly and existing in harmony. For instance, Thames Water [9], the major supplier of consumption and waste-water facilities in the UK, is utilising sensors, and actual data acquisition and analytics to foresee equipment failures and make available immediate response to crucial circumstances, such as seeps or adversative climatic events. Firm has already fixed over 100,000 smart meters in London, which intends to cover clients with smart meters by 2030. 4,200 leaks were sensed on client pipes, hence, this setting has already saved a projected 9,30,000 litres of water daily for London. Also, the deployment of 800 HART devices for actual process management at Mitsubishi chemical plant in Kashima, Japan has been rising the production operation by redeeming US$20-30,000 daily that also averted a $3million shutdown [10]. Agriculture controlled by IIoT can help farmers better in measuring diverse agricultural variables like soil nutrients, fertilizer used, seeds planted, soil water, and temperature of warehoused produce, letting to observe to the square foot via a thick sensor deployment, thus approximately increase by two-fold the productivity [11,12,13]. Firms like Microsoft (Farm- Beats project [14,15]); Climate Corp [16], AT&T [17], and Monsanto [18] are endorsing agricultural IoT. IIoT will be able to also drastically power in the healthcare field. In hospitals, human or technological blunders initiated by false alarms, sluggish reply, and erroneous information are still a crucial purpose of preventable demise and patient suffering. By

linking distributed medical devices by way of IIoT technologies, hospitals can notably overcome these drawbacks, thus improving patient safety and skills, and further capably using the resources. IIoT also offers prospects to improve effectiveness, safety, and operating situations for employees. Instance, via unmanned aerial vehicles (UAVs) lets examining oil pipelines, observing food safety with sensors, and lessening workers' exposure to sound, and dangerous gases or chemicals in industrial settings. Instance, Schlumberger uses observing subsea situations with unmanned marine automobiles journeying through oceans and gathering statistics for up to a year deprived of fuel utilization or crew, progressing under power produced from wave energy [19]. Via remote observing and sensing powered by IoT, mining industries can significantly decline safety-related events, while making mining in severe sites more efficient and productive. IIoT is a technology which not only enhances businesses but is also an eco-friendly technology which benefits the environment and mankind as whole.

5.1. IIoT Challenges

There are prospects for IIOT, it's a necessity to capitalise more in solving the core challenges that we face today. If these challenges are solved it's a huge step ahead saving the environment globally. Energy Efficiency, Real Time Performance, Coexistence and Interoperability, Security and Privacy.

Figure 10. IIoT Challenges

6. Conclusion

These days IoT technologies is up surging swiftly so, the world might rapidly move to a single numerous connected network existing to all. Multiple researchers globally are working harder to aim a norm environmental sensor network steered by IoT technology. Climate change management with latest technologies is only a beginning. Public and private affiliations will need to work together to grow the investing ratio in these developments. IoT and IIoT will offer pragmatical climate data. It would also give a power to ecological wastes by emanating up of individuals, energy and nature. It will maintain adapting, as researchers and technology developers attain recent assent on the act we need to take to guard ourselves not only contrary to increasing temperatures and hazardous climate modifications but also contrary to cyber-attacks.

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MITIGATING CLIMATE CHANGE THROUGH SUSTAINABLE EDUCATION

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This article focuses on the cases of the education sector which are untapped, which has opportunity to balance climate change. It defines Climate Change Education for Sustainable Development that is comprehensive and multidisciplinary and asserts that it should not only include relevant content knowledge on climate change, environmental and social issues, disaster risk reduction, but sustainable consumption and lifestyles, and also a focus on the institutional environment in which those content are learned to ensure that schools and education systems themselves are climate-proofed and resilient as well as sustainable and green. The present article focuses on evidence-based findings on the factors that influences skills, attitude and behaviour change the most, in order to determine what works for formal and non-formal climate change education content, which includes environmental education, climate change and scientific literacy, and education for sustainable lifestyles and consumption. **Main challenges are Prescriptive, inflexible, non-inclusive and overcharged curriculum.**

1) Rather than participatory and transformative approaches to education passive and transmissive to be adopted.
2) Lack of materials in multi linguistic language other than in English in many places.
3) Less or no framework for establishing quality or appropriateness for a given context.
4) Unavailability of materials to address the ethics, justice & uncertainty issues and the social dimensions of climate change mitigation and adaptation.
5) Problems in sharing information from different sources and locations among many diverse networks and Priority Areas.

Areas essential for Action

- A review of existing educational policies and curriculum are essential and important, to start with the development of guidelines, to facilitate the inclusiveness of climate change issues into educational programmes, policies and curriculum.
- A detailed review of inventory and existing tools, materials and practices in teaching and learning climate change.
- Ensuring quality assurance and standard setting in climate change education.
- Developing new ways for supporting a community of practice around climate change education.
- Developing networking and cooperation for action on climate change education among all stakeholders especially particularly through actively engaging communities and youngsters
- Developing action-research in social and human sciences, ethics and adaptable teaching materials to match specific situations in relation to climate change issues.
- Scaling up of existing relevant and good initiatives.
- Primary purpose should be to serve as a coordinating mechanism to review existing climate change education resources including curriculum, prepare new materials and promote field activities and networking mechanisms on the ground.

Review of Literature:

Fernandez and Shaw (2013),: In his article he throws light on youth's awareness on climate change must be integrated even in the formulation of disaster risk reduction plan.

This is important as the youths are among the marginalized sector of the society that bears much of the impacts of disasters and how to overcome it.

Gaillard &Pangilinan, 2010: In his Article focus on the disaster risk reduction processes essential to reduce risk.

Peek (2008): In his article emphasis on youth's knowledge, creativity, energy, enthusiasm, and social networks that could be tapped in various phases of disaster risk reduction processes which will help themselves and others.

Significance of the study:

The study is therefore essential to know factors essential for climate change, its impact and measures for its action.

The Role of HEIs in enhancing climate change.

Empowerment is essential in equipping change with the necessary competencies and resources required to make an impact in climate change adaptation.

The traditional mission of higher education institutions (HEIs) is to enhance youth awareness with the help of teaching and research function. The role of higher education in society must be expressed as its key mission of producing and spread knowledge engaging the community in the learning process. In the issue of climate change, its necessary for higher education to impact the individuals' general awareness of the issue while at the same time, to determine how enabled they are to develop the necessary actions, solutions and innovations to overcome this climate change. Education provides the skills, knowledge to people needed to thrive in the new sustainable economy, working in areas such as renewable energy, smart agriculture, forest rehabilitation, the design of resource-efficient cities and sound management for healthy ecosystems. Additionally, improving education can give people the skills and knowledge to prepare better for and recover from natural disasters.

It's being analysed that the education tends to be the single, strongest predictor of awareness of the climate change. It is here where the role of higher education institutions is increasing in societal awareness of climate change. Universities should create amongst society a very high basic scientific literacy. This is necessary because it can help increase a community's ability to solve and adapt to climate change by enabling members to make informed decisions about climate and the factors that impacts it.

Universities must engage themselves with local, national, continental and global challenges. The functions of higher education in the society should however be directed by the pursuit of excellence in teaching, training, research and institutional performance as well as the perceived priority needs of the society to address climate change challenges. Higher education must strive a balance between short-term service and long-range quality, between basic and applied research and between professional training and general education that would create a disaster resilient society or society with high climate change literacy. In this way, the link between higher education institutions and society could be observed in terms of the adoption and implementation of strategies and interventions in managing climate-related vulnerabilities and risks . The development of an integrated conceptual framework for strengthening the capacity of universities to help society understand and respond to a wide range of sustainability challenges is therefore essential. A large amount of work has already been carried out by many countries on assessing impacts and vulnerabilities to climate change, as well as considering possible adaptation options. Developing countries have very different, individual circumstances and the specific impacts of climate change on a country depend on the climate it experiences as well as its geographical, social, cultural, economic and political situations. As a result, countries require a varied diversity of adaptation measures very much depending on individual circumstances.

Education plays a vital role in educating people about change in environment, making them sense about it, take preventive measures and acting according to the situation. Through enough preventive approach mitigation can be done. It cannot be done overnight, lots of necessary measures needs to be taken. Technology change, new innovative methods, obsolesce awareness, outdated mechanism are also need of environment change system, which also needs to be addressed, which cannot be ignored by the society, its part of the societal system and required for development .

Conclusion: Higher education needs to suspect to climate change and make probable arrangements so that education are unaffected in effected areas. Education has always played a vital role in making people aware and enhance information.

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IMPACT OF CLIMATE CHANGE ON UNIVERSITY PROCESSES

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Climate change has taken centre corner stage in global diplomacy. A large amount of work has already been carried out by many countries on assessing impacts and vulnerabilities to climate change, as well as considering possible adaptation options. Developing countries have very different way to handle and also ih as specific impacts of climate change on a country depend on the climate it experiences as well as its geographical, social, cultural, economic and political situations. As a result, countries require a diversity of adaptation measures very much depending on individual circumstances. However, there are cross cutting issues which apply across countries and regions. The same sectors are affected by climate change, albeit to differing degrees. Global warming is a incorrect because it implies something that's gradual, that's uniform, that's mostly talk about temperature, and is quite possibly benign. What's happening is rapid, nonuniform, affecting everything about climate, and almost its entirely harmful. A more accurate term is 'global climatic' disruption.

Most of the Colleges and universities are being swept up in these developments which requires strategic planning to be undertaken. As an aid to those campuses starting such planning, we must include here a brief review of the increasingly serious nature of climate change and the corresponding legislative and regulatory rules that are being put in place and that will affect higher education institutions.

Regulations and its Potential Impact on Higher Education Institutions

It is important to note that the category of regulated entities will likely include colleges and universities, many of which are essentially small cities, especially those that have their own power plant to generate heat and/or electricity. Another initiative attracting interest is the energy efficiency and emission reduction should be key priorities in a forthcoming government framework for higher education over the next ten to fifteen years. All the states of Higher education should be at the forefront in understanding the seriousness of climate change and adopting policies.

As awareness of climate change implications grows on campuses, especially with respect to the impending costs of cap-and-trade systems or carbon taxes, colleges and universities are undertaking to assess and evaluate their biggest contributors to GHG emissions. On many campuses, particularly research-intensive institutions, cyberinfrastructure including data centres and local clusters that can be a dominant contributor of CO_2 emissions if the electricity is generated by coal-fired power stations.

Till date, campus IT operations, including those of faculty who set up their own departmental clusters, have largely operated under the radar when it comes to measuring or paying for the utility costs associated with those operations. But as colleges and universities discover that cyberinfrastructure is mostly significant responsible for increased costs associated with electricity, cooling, and carbon offsets, they will be under the gun to produce a solution.

On the positive note , increased energy efficiency and virtualization can lead to improvements in electrical consumption; but it is also likely, given the history of computing, that gains in efficiency will be quickly overwhelmed by the increasing demands for new applications and the increasing trend for larger and bigger datasets as more science becomes dependent on high-performance computing and networks.

Climate change will have wide-ranging impact on the environment, and on socio-economic and related sector which includes water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity

and coastal zones. Change in rainfall pattern are likely to lead to severe water shortages and/or flooding. Melting of glaciers can cause flooding and soil erosion. Rising temperatures will cause shifts in crop growing seasons which affects food security and changes in the distribution of disease vectors putting more people at risk from diseases such as malaria and dengue fever. Temperature increase will potentially severely increase rates of extinction for many habitats and species. Particularly affected will be coral reefs, boreal. Evaluating the impacts of and vulnerability to climate change and subsequently working out adaptation needs requires abundant quality information. This information comprises of climate data, such as temperature, rainfall and the frequency of extreme events, and non-climatic data, also such as the current situation on the ground for different sectors including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity, and coastal zones

Action required by universities

Information Gathering-data, Systematic Observation and Monitoring - For countries to understand their local climate better and thus be able to predict local climate change, they must have adequate operational national systematic observing networks, and access to the data available from other global and regional networks. Systematic observations of the climate system are usually carried out by national meteorological centres and other specialised centres. They take observations at standard preset times and places, and monitor atmosphere, ocean and terrestrial systems. The major climate variables measured include temperature, rainfall, sea surface temperature, sea level rise, wind speeds, tropical cyclones (including hurricanes and typhoons), snow and ice cover. A sure knowledge base from systematic observation and forecasting services is essential to monitor climate; detect and attribute climatic change; improve the understanding of the dynamics of the climate system and its natural variability; provide input for climate models; and thus plan adaptation options. For example, monitoring trends of sea surface temperature and sea level are essential in order

Assessing the Impacts of , and Vulnerability and Adaptation to climate change- to assess their impacts on the increased intensity of tropical cyclones and storm surge; monitoring events relating to the phenomenon effects on reducing or increasing precipitation in different regions leading to both floods and drought. The plans highlight the need for a better knowledge base, better forecasting and climate services and a need to improve observations at all levels to enhance countries' ability to adapt. They emphasise that effective adaptation planning requires improved observations; improved regional, national and global data, as well as denser networks; the recovery of historical data; building of support among the user communities that have a demand for climate information; and promoting greater collaboration between the providers and users of climate information.

Is climate change just speculation? No. The earth's climate has been changing continually for millions of years. Scientists know many of the things that cause changes in the climate, and they also know that, increasingly, human activities are contributing to climate change. For example, evidence taken from ice-core measurements show that the increases in atmospheric concentrations of carbon dioxide that have accompanied human industrial activity are unlike anything that has happened naturally over the last 650,000 years. Currently the climate is changing as a result of a rise in average temperatures, commonly called global warming. As global warming occurs, not every day or every place will be warmer, but on average most places will be warmer. Warming will cause changes in the amount and pattern of rain and snow, changes in the length of growing seasons, changes in the frequency and severity of storms, and changes in sea level. These changes will, in turn, have an impact on many human activities. The fact that climate does change continually, however, has encouraged some to challenge the scientific consensus concerning climate change. Two challenges have achieved prominence. First, while accepting that the earth is warming,

some argue that human activities are not responsible. Second, some argue that future climate change will almost certainly be very small, and, as a result, will require humans to do very little to mitigate the effects or adapt their behavior to account for climate change. However, climate researchers point out that: "These skeptical arguments are rarely if ever advanced in scientific arenas, but in editorial pages, on the internet, or in policy arenas where more lenient standards for evidence and argument apply." Having been advanced in non-scientific arenas, sceptical arguments are then often uncritically recounted in the media to 'balance' against scientific arguments for climate change. Climate is the average pattern of weather in a particular region of the world. Climate usually remains relatively stable for centuries—if it is left to itself. However, the earth's climate is not being left to itself: Human actions impact the earth and its climate in significant ways. Climate is different than weather. Weather is the condition of the atmosphere at a particular place and time. Weather is measured in terms of such things as temperature, humidity, and precipitation (rain, snow, etc.). Weather changes all the time, and, in most places, it can change from hour to-hour, day-to-day, and season-to-season. Climate, on the other hand, is the average pattern of weather.

Conclusion: Climate change is inevitable, measures to be taken to take utmost care to protect the effected people and make necessary arrangements required for the same.

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ROLE OF STUDENT SENSITIZATION IN COMBATING CLIMATE CHANGE

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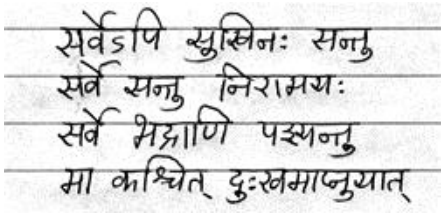
Abstract:

Nature is nurturing, provided we respect it. Environment concerns have been quite on our minds. Climate change has been a major spotlight as the effects of this are life taking. Number of instances showing the ill effects of climate change have been seen. The instances of increase in sea level, melting of glaciers have been observed. The shifting of climatic conditions has affected food grain production, flora and fauna balance etc. This is affecting the entire planet. Thus, it becomes imperative to sensitize the world citizens and bring a change in their behaviour. The Sensitization process needs to start early in order to ingrain environmentally friendly behaviour. Thus, the focus has been on the university student groups in order to understand the perspective and activities towards environment conservation.

Keywords: Climate Change, Environment Conservation, Students, Awareness

Introduction



"Let everyone in the world be happy and contented and world will be a better place to live". From ages together, human beings have been wanting to live in the ideal situations. The living conditions and climate plays an important role in fulfilling these ideal conditions. However, the conditions are no more ideal in terms of climate. Global warming, alarming levels of non-degradable wastes, threat to the marine life are to name a few of the environmental hazards. Humans, flora and fauna are affected causing a disbalance in the nature. This disbalance in turn creates health hazards and poor living conditions. If this continues to be the scenario, the life on the planet is endangered. Is this the commencement of Vedic phenomenon "Pralaya" which means end of the world?

Its high time the roles and responsibilities towards environment are understood and acted upon. There are numerable agencies, governance bodies are taking important steps towards conservation of environment and to make environment for sustainable for future generations.

The times are changing and so is social dynamics. Earlier students used to spend considerably less time at schools as compared to the present scenario. The same is applicable to the working professionals as well. The time required for commuting to office space has increased due the formation of Special economic zones, IT parks and of course the number of vehicles on the road causing traffic jam.

A study on climate change in Nigeria has revealed that there is much needed educational awareness among the university students of the country. The importance of integration of climate change studies can be integrated in primary and secondary schools' curriculum was reiterated. Countries across the world should focus on promoting green technology across the world. Frequent organization of seminars, programs, awareness sessions can help in sensitizing the future citizens of the country (Ogunsola, 2018).

There are umpteen number of attempts made to educate the people around the world about the effects of climate change. The governance bodies of various parts of the world are trying to make students to make changes in certain actions to tackle the climate changes. It also focuses on the current scenario of actions by individuals and industries leading to climate

changes. These climate changes are sudden and undesirable in nature.

2. Review of Literature

The governance bodies in the respective countries are imparting climate education to heighten the sense of awareness towards climate change. This also helps to initiate necessary corrective actions towards the climatic changes.

Giusto (2018) has said that students are expressing greater concerns over changing environmental conditions. The students expressed more concerns over eastern and southern Taiwanese regions and were more vulnerable to extreme weather conditions. It has been expressed that in the western society an East Asian model has been suggested in which conflict between economic growth and environment needs stronger policy intervention to be addressed. Also, higher levels of behavioral changes were reported in the students expressing greater concerns and even with less knowledge about climatic changes.

Haynes (2019) had tried to bring out the climate awareness among the student groups. There is mention of students, belonging to the age group of 15 to 20 years who protested against the lack of actions and responsibility against the climate change. The students were concerned about their future and were keen to improve the climatic conditions. As per warning of landmark Oct 2018 report from United Nations the planet is supposedly 12 years away from a catastrophe unless certain drastic steps are taken to curb the environmental changes. There is a need felt to do lot of work to be done as the timelines are very short.

HanraHan & SHafer (2019) had emphasized on curricular changes and its effect on the awareness among students especially in the undergraduate atmospherics program. There were curricular changes that incorporated more infographics, science videos, interwoven formal and informal communication assignments. This had also resulted in changing the mindset of the students. There was great interest in climate related courses and activities. Students were also interested in climatology and climate change related studies. The respondents also were on the opinion that presently the communication ecosystem is very open and hence scientists do communicate the changes and information to the public.

Worland (2019) had described the plight of Fijian Islands due to climate change. Once home to around people has been overrun by tropical forest. People of these areas have fear of few areas being wiped out from the map completely. Even half degree change in temperature was a topic of discussion and would determine if the island will exist or not in the times to come. The individual initiatives should be a part of collective initiatives that would require the world leaders to intervene. It is easy to see Islands as distant lands with distant problems but there might be threat to its very existence.

Jigyasu (2019) expressed that climate change comprises of much more than global warming. It comprises of increase in humidity, scarcity or excess of rains and also increase in extreme weather conditions. The rising sea level and other hazards are an ongoing event. Various practice around the world to discuss the success and failure in dealing with challenges has been discussed.

Statement of Problem: Climate is changing rapidly and has had tremendous effect on the environment. In the recent times though we have seen very positive changes in the environment amongst the lockdown during COVID-19 pandemic. However, retrospection makes us aware of the situation might be back to what it was once the pandemic settles down. The environment needs to be preserved and protected for sustainable human life. So, it is very important to sensitize the young generation especially the students towards environment preservation. It becomes extremely important to sensitize students at the right age so that it is put into practice for a lifetime. This will create a sustainable eco-system for generations to come.

3. Research Methodology:

Statement of Problem: This topic much required to curate to understand the role of education in combating climate change. The effect of climate change on the planet has given rise to many anomalies in nature. The effects like rise in the sea level, global warming, melting of glaciers are prominently seen. The effects are steadily shown and are threat for the generations to come. However silver line still exists. The corrective measures can help to minimize the hazardous effect. The research focuses on role of student sensitization towards environment to combat the climate change.

Type of research: The study will be descriptive and analytical in nature as it will describe various dimensions of climate change. It is also aimed at solving the problem of climate change in the future.

Population: Students of various programs

Sampling frame: Students studying in Bangalore

Sampling method: Convenience sampling.

Sample size: 117 students

Data collection: Primary Sources: The primary data collection is done through survey method and conducting the interview with few students to understand their perception and preferences.

Data was also drawn from secondary sources like journals, articles, blogs etc. to study the concepts in greater details.

Hypothesis testing:

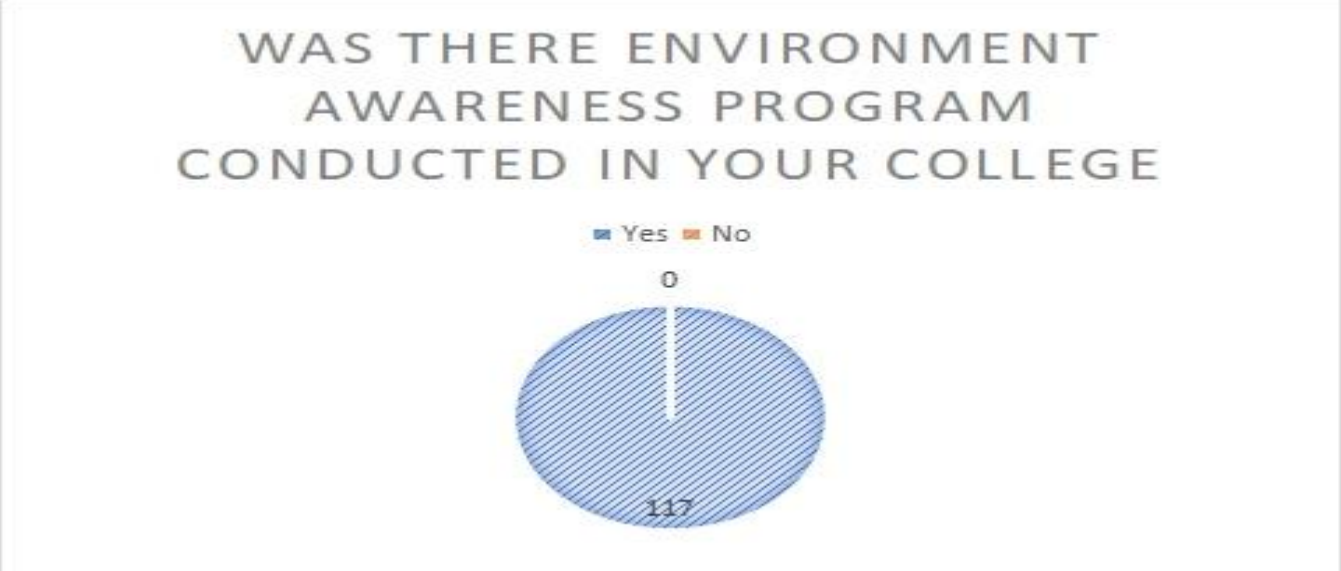
H1: The student sensitivity towards environment is dependent on awareness about the environment conservation.

H0: The student sensitivity towards environment is independent of awareness about the environment conservation.

4. Data Analysis and Interpretation:

The data was collected from 117 students through circulation of a questionnaire. The data was analyzed and interpreted as follows:

Chart no. 1: Conduct of environment awareness program in the college



Source: Field Survey

Data Analysis and interpretation: According to chart no. 1, all the respondents agree to the fact that colleges conduct environment awareness program. Al the educational institutions make a conscious effort of conducting environment awareness programs in various forms like Guest lecture, seminar,

marathons etc. Educational institutions have been a great instrument in spreading awareness amongst the future citizens.

Hypothesis testing:

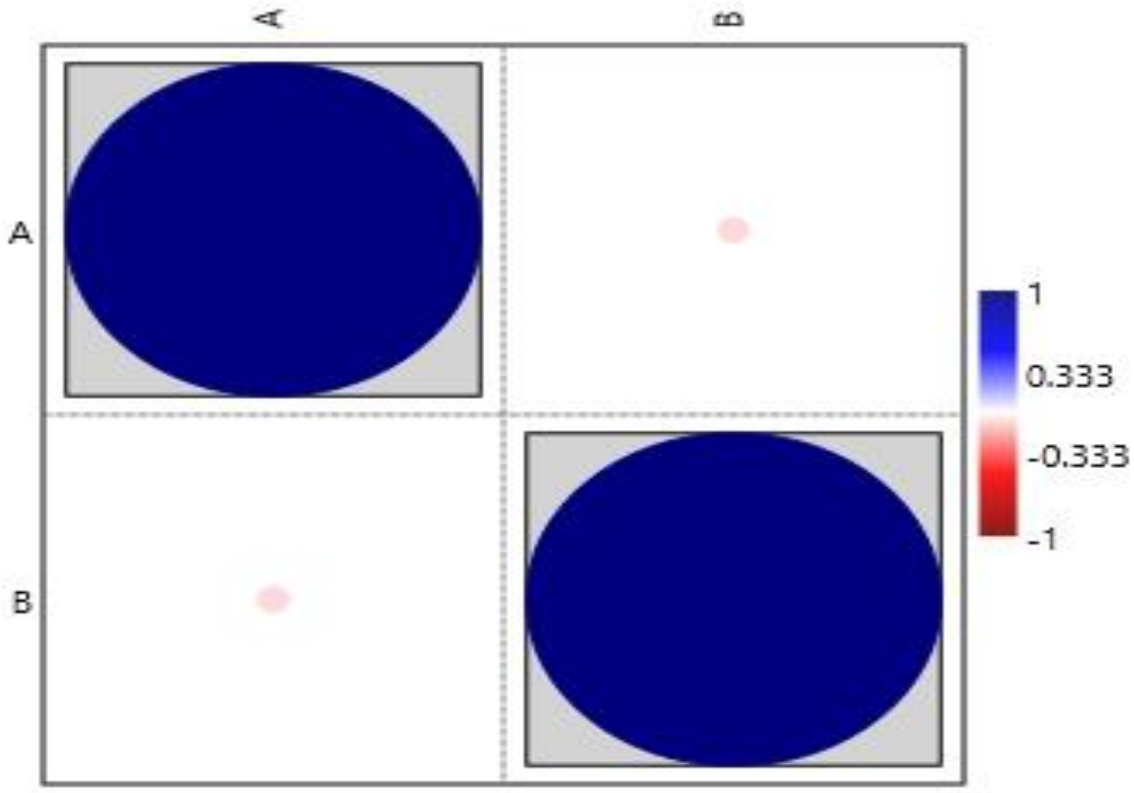
H1: The student sensitivity towards environment is dependent on awareness about the environment conservation.

H0: The student sensitivity towards environment is independent of awareness about the environment conservation.

Chart 1: Chi Square test results:

	A	B
A		0.0717
B	0.0717	

Figure no 2: Chi -square results:



Data Analysis and Interpretation – As seen in Figure no 2 and Chart no. 1, the p value is less than 0 which is 0.0717. Therefore, it is concluded that the student sensitivity towards environment is dependent on awareness about the environment conservation. As seen in chart no.1, column A represents the data about whether had attended program pertaining to environment awareness and column B represents the data pertaining to disposal of waste in a specific situation. The data was analysed using PAST software, version 4.03. From the Analysis it is evident that environment awareness programs have positive effect on the behaviour of the students. They tend to understand the importance of behavioural changes in order to combat climate change and conserve the environment. The Educational institutions have always been spreading awareness about the environment through seminars, guest lectures, CSR. Marathons etc. This effort has been quite successful and the results show positive behavior of students towards the environment.

5. Discussions and Conclusion:

The primary data had some thought-provoking revelations. Students are much interested in the action oriented and fun type of activities pertaining to environment. They include mostly Marathons, Quiz, Contests, Fashion shows, treasure hunts, rallies, volunteering programs etc. This will also help the institutions to make the environment awareness program more student centric. These activities not only have high enjoyment quotient but also have high impact on the behavior.

Most of the educational institutions are committed to spread awareness about the climate change and environment conservation. Some autonomous institutions have made an effort to integrate it as a part of their curriculum. To increase the gravity of the course it can be assigned credits. Integration of a project-oriented approach is also a viable option.

The data also projected that environment awareness programs had started from the school. The students were exposed to the importance of conserving environment. Schools were also engaged in taking up activities like tree plantation etc.

Educational institutions always play an important role in shaping the attitude and behaviour of the students. At a young age, the institutions can mould the students into responsible citizens. This can lead to solution of many environmental hazards. With every environment awareness program there is continuous reinforcement to exhibit environment friendly behavior. This helps to bring about the desired change in the behavior right from childhood.

Climate change has been a very serious concern. There are umpteen number of researches that are carried on in these regards. The researchers are of the opinion that we can still reverse the effects of the climate change with taking the right precautions and necessary actions. Environment education plays an important role in this regard. The educational institutions have played a very important role in inculcating the right behaviour amongst the students. This instils the right behaviour required to combat climate change and make world a better place to live. The educational institutions have also adopted innovative methods of spreading awareness towards environment conservation and thus battling the climate change. It has to be a collaborative effort between all stakeholders of the environment which all of us. COVID-19 has been a lesson for the entire world which taught us that if we don't appreciate nature and take care of it, nature has its own way of taking care of self.

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THE ROLE OF GOVERNMENT, ACADEMIA AND INDUSTRY IN COMBATING CLIMATE CHANGE

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Abstract

Promotion of Energy Audit and Conservation of Energy (PEACE) Scheme plays a major role for Government, Academia and Industry in Combating Climate Change in Tamil Nadu. The objectives is to study on the performance of awareness programme conducted, performance of training conducted, the energy audit conducted and implementation of energy audit for MSMEs under PEACE Scheme. The methodology adopted is collection of primary data from Department of Industries and Commerce, Government of Tamil Nadu for all districts in Tamil Nadu and the data were analyzed with Correlation Analysis and, Regression Analysis, by taking No. of Units [U], as independent variables and amount Spent for energy efficiency activities in Lakhs as Dependent Variables. There is substantial achievement in physical and financial target on awareness, training, energy audit and implementation. The PEACE scheme achieves SDG goal 7 of Government of India and Tamil Nadu and will have better energy efficiency for MSMEs which will leads to improvement in climate change. To conclude, the Role of Government, Academia and Industry plays a major role in combating Climate Change.

Key words- Government, Academia, Industry, Climate Change, Tamil Nadu

1. INTRODUCTION

The Government of Tamil Nadu have introduced Promotion of Energy Audit and Conservation of Energy (PEACE) scheme for promoting Energy efficiency in MSME units. [1]. Under this scheme the Government will reimburse 50% of the cost of conducting energy audit and 25% of the cost of machinery & equipment replaced, retrofit and technology acquired for the purpose of improving the energy efficiency, based on the recommendation of Energy Audit. This will have reached the target of Sustainable Development Goal (SDG) 7.

Tamil Nadu exceeds the national average, constituting over 10% of the total energy savings potential of 75,364 million units (MU) across all States in India, as per study conducted by National Productivity Council Tamil Nadu offers tremendous opportunities for mainstreaming energy efficiency (EE) initiatives across all sectors, particularly in the Industrial Sectors.

Energy Efficiency potential in the State largely remains unrealized owing to various technical, financial institutional and information barriers.

The barriers are

a. Deficiency of Internal Financing and limited access to bank financing for MSMEs.
b. Paucity of information.
c. Awareness and communication regarding EE options.
d. Cost of project development and transaction.
e. Insufficient risk assessment.
f. Insufficient training and capacity building of Energy Service Companies (ESCOs) and bank officials.

2. TECHNICAL SURVEY

2.1 Rationale for Promotion of Energy Efficiency in MSME Sector

The Large number of Micro, Small and Medium Enterprises (MSMEs) like foundries,

brass, textiles, refractory units, brick, ceramic, glass, utensils, rice mills, Food Processing unit, Plastic Units, Khandsari manufacturing units and continues process industries etc are said to have large potential for energy savings. Many of these units are in clusters located in various districts of the country. Majority of MSMEs are typically run by entrepreneurs who are leanly staffed with trained technical and managerial persons to deploy and capture energy efficiency proactive to reduce manufacturing cost and increase competitive edge. Therefore, it will be useful to build their energy efficiency awareness by funding / subsidizing need based studies in large number units in the MSMEs and giving energy conservation recommendations including technology upgradation opportunities.

It is envisaged that such interventions supported by diagnostic studies and pilot projects at cluster level [2] [3] focusing on energy / resource efficiency, energy conservation and technology upgradation. This would help in addressing the cluster specific problems and enhancing energy efficiency in MSMEs. Accredited Energy auditors will initiate diagnostic studies in MSMEs to prepare unit specific energy efficiency manuals covering specific energy consumption norms, specific energy consumption norms, energy efficient process and technologies, best practices, case studies etc. These studies would provide information on technology status, best operating practices, gap in skills and knowledge, energy conservation opportunities, energy saving potential etc for each of the subs-sector in MSMEs. The studies / projects will also be specific energy conservation programs in MSME sectors.[4]

To accomplish the above task for Promotion of Energy Efficiency and Energy Conservation (PEACE), there is need for study of the scheme.

3. OBJECTIVES OF THE STUDY

The objectives are

1. To Study on the performance of awareness programme conducted for MSMEs under PEACE Scheme.
2. To study on the performance of training conducted for MSMEs under PEACE Scheme.
3. To study on the energy audit conducted for MSMEs under PEACE Scheme.
4. To study on the implementation of Energy Audit for MSMEs under PEACE Scheme.

4. METHODOLOGY:

The methodology adopted is collection of primary data from Department of Industries and Commerce, Government of Tamil Nadu for all districts in Tamil Nadu and the data were analyzed with Correlation Analysis and Regression Analysis, by taking No. of Units [U], as independent variables and amount Spent for energy efficiency activities in Lakhs as Dependent Variables.

5. STATISTICAL ANALYSIS

5.1 Awareness Program

Awareness among MSMEs in the level of understanding about the importance and implications of energy audit and conserving energy. Raising awareness among MSMEs is not the same as telling them what to do-it is explaining issues and disseminating knowledge to them so that they can make their own decisions. High awareness among MSMEs occurs when a significant proportion of the MSMEs agrees that the energy audit and conserving energy is an issue that is of great importance to the financial performance and competitiveness of their enterprise.

Awareness program content shall be matching to the requirement of MSMEs / Sectors / Clusters. Content of course material is provided in softy copy and hard copy. The program is designed for one day, based on the need and requirement of the MSMEs. The Target group of participants are Executives, employees, workers of MSMEs and cluster members. Minimum number of participants are 40-5- (ideal size). However, in industrially backward districts the batch size may be lesser.

The resource persons may preferably be drawn from the organizations such as Petroleum

Conservation Research Association (PCRA), India SME Tech Services Ltd (SIDBI) and National Productivity Council (NPC), BEE, TERIs etc., which are promoted by Government Departments. However, Bureau of Energy Efficiency (BEE) accredited Energy Auditors / Managers with rich experience in energy audits, energy management and conservation and BEE empanelled Energy audit firms / cos., may also be engaged.

The programme will be organized by GM,DIC/ RJD, Chennai in coordination with MSMEs Associations, Product Associations, Clusters and other Stakeholders. Wherever possible the awareness programmes may be organized sector / cluster specific.[5]

Physical and financial Performance

The district wise physical and financial performance on the awareness programme conducted for MSMEs in Tamil Nadu is given in figure 1.

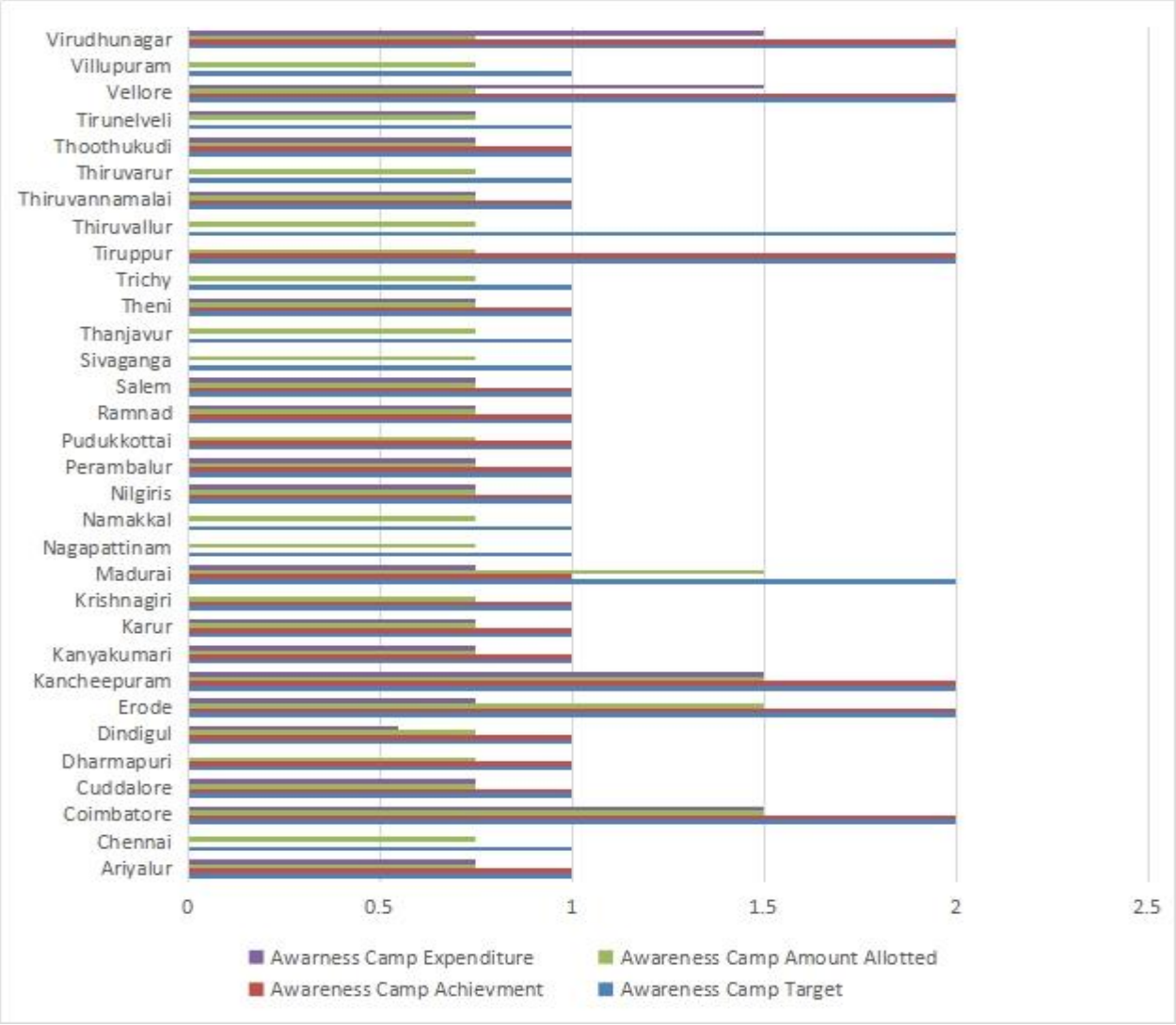

Figure 1: Physical and Financial Performance of Awareness Camp

As per figure 1 majority of the districts are achieved the awareness camp conducted on PEACE Scheme and also on the expenditure.

Overall Performance

The overall performance on the awareness programme conducted for MSMEs in Tamil Nadu is given in figure 2.

Figure 2: Overall Performance on Awareness Programme under PEACE Scheme.

Correlation Analysis

The correlation analysis is given in table 1.

Table 1: Correlation Analysis

	Awareness Camp Target	**Awareness Camp Achievement**	**Awareness Camp Amount Allotted in Rs. lakhs**	**Awareness Camp Expenditure in Rs. lakhs**
Awareness Camp Target	1.00			
Awareness Camp Achievement	0.90	1.00		
Awareness Camp Amount Allotted in Rs. Lakhs	0.65	0.51	1.00	
Awareness Camp Expenditure in Rs. lakhs	0.76	0.86	0.37	1.00

Table 1 reveals that there is high degree of relationship exists between awareness camp target and achievement and also the moderate degree of relationship between fund allotted for awareness camp and expenditure awareness camp.

Regression Analysis

The regression analysis is given in equation 1.

A = 0.34 + 1.05 E ……[1]

where $R^2 = 0.53$ and p = 0.00

One unit increase in Awareness Camp Expenditure in Rs. lakhs (E) will lead to 1.05 unit increase in Awareness Camp Achievement

(A). Hence awareness camp plays a major role in energy efficiency.

5.2 Training Program

The objective of the training programme is to enable MSMEs to establish the systems and processes necessary to improve energy performance, energy efficiency, and help reduce energy consumption and costs. The participants will learn how an effective Energy Management System (EMS) can help to their organization improve energy efficiency, reduce costs, and lower greenhouse gas emissions. The training programme enables the MSMEs to take a systematic approach towards achieving continual improvement in energy management

Tailor made training program in conformance with the requirement of MSMEs / Clusters. For instance, programmes could especially fashioned around utilities and systems that a particular industry is dealing with on a day-to-day basis (energy audit and conservation in electrical systems like maximum demand control, power factor control motor survey, transformers, pumps, fans, air-conditioning units, chillers, DG sets, lighting systems, air compressors etc. and in thermal systems like boilers, furnaces, driers, thermic fluid systems, heat exchangers, steam system etc.)

Content of course material will be provided in soft copy and hard copy. The course will be for 3-4 days, based on the need and requirement.

Target Group of Participants / Eligibility are Employees, Engineers and executives of MSMEs which are willing to undertake the energy audit. Wherever possible the training programme will be organized focusing sector / cluster wise. The ideal batch size will be 20-25. In case of organizing cluster / sector focused programmes, MSMEs from neighbouring districts is included.

The training faculty may preferably be drawn from the organizations such as Petroleum Conservation Research Association (PCRA) India, SME Tech Services Ltd (SIDBI) and National Productivity Council (NPC) etc., which are promoted by Government Departments. However, Bureau of Energy Efficiency (BEE) accredited Energy Auditors / Managers with rich experience in energy audits, energy management and conservation and BEE empanelled Energy audit firms / cos., are also be engaged.

The training will be organized by GM, DICs / RJD, Chennai in coordination with MSMEs Associations, Product Associations, Clusters and other stakeholders. Wherever possible training may be organized sector wise /cluster wise / product wise.

The performance on training conducted are given in figure 3 and figure 4.

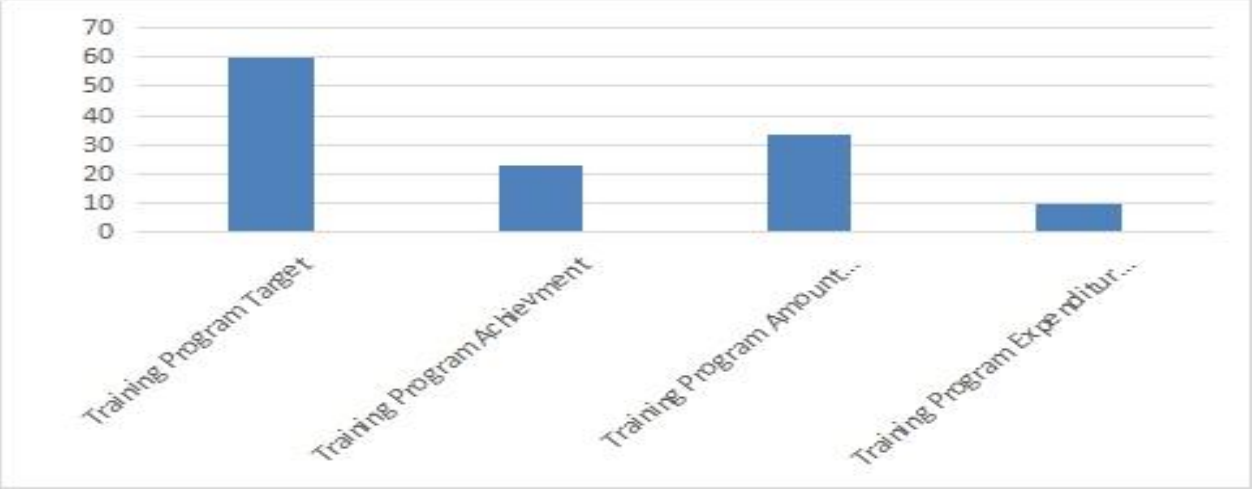

Figure 3: Performance on Training Programme conducted

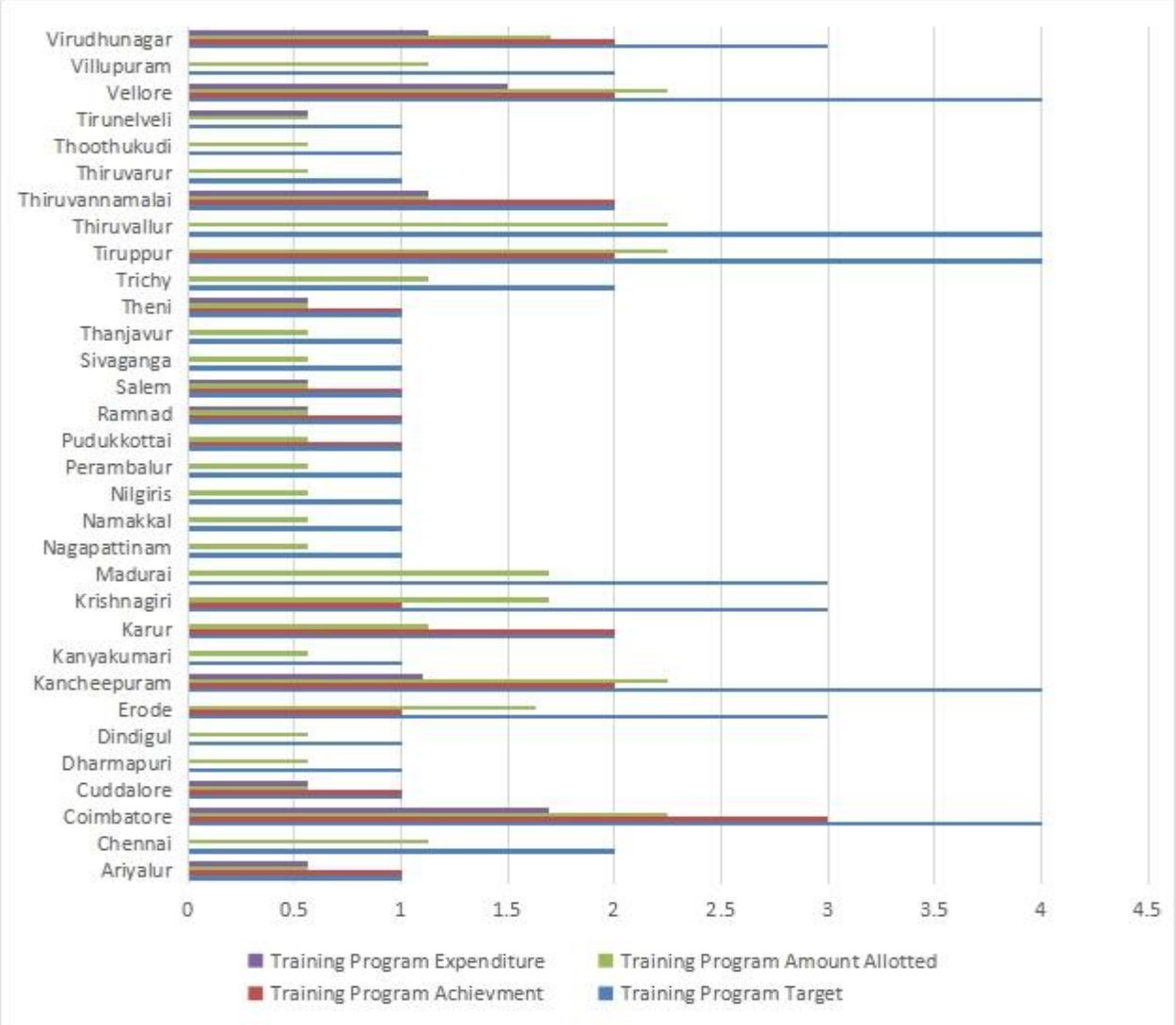

Figure 4: District Wise Performance

Correlation Analysis

The correlation analysis is given in table 2.

Table 2: Correlation Analysis

	Training Program Target	Training Program Achievement	Training Program Amount Allotted	Training Program Expenditure
Training Program Target	1			
Training Program Achievement	0.72	1		
Training Program Amount Allotted Rs. In Lakhs	1.00	0.73	1	
Training Program Expenditure in Rs. Lakhs	0.93	0.96	0.93	1

Table 2 reveals that there is high degree of relationship exists between Training Program Target and achievement and also the high degree of relationship between fund allotted for Training Program and expenditure on Training Program.

Regression Analysis

The regression analysis is given in equation 2.

T = 0.30+ 1.36 E……[2]

where R^2 = 0.58 and p = 0.00

One unit increase in Training Program Expenditure in Rs. Lakhs (E) will lead to 1.36 unit increase in Training Program Achievement (A). Hence Training program has major effect on energy efficiency increase in MSMEs.

5.3 Detailed Energy Audit

Main objective of energy audit is to identify the major sources of energy in use, identifying the lapses in energy usage, identifying areas to improve energy usage, determining the level of consumption of the energy sources and recommending policy measures that will enhance energy savings in the industry.

An effective energy management system can help MSMEs cut their energy costs and reduce their environmental impact. It provides a structural review of how energy is being purchased, managed and used with the aim of identifying opportunities for energy cost saving through improved services.

I. A detailed energy audit covering significant electrical, mechanical and thermal utilities to bring out energy conservation measures.

ii. Estimating the gate to gate energy consumption of each enterprise for arriving at baseline data for benchmarking with standard data.

The following methodology is suggested for adoption.

i. Plant survey

ii. Discussion with the plant personnel.

iii. Analysis of past performance data.

iv. Measurements of required electrical parameters.

v. Energy Performance assessment for significant electrical and thermal equipment.

vi. Comparison with available performance guarantees / manufacturer design data.

vii. Identification of energy conservation measures.

viii. Discussion of the findings and recommendations with plant personnel.

ix. Detailed techno economic analysis.

x. Report submission.

Bureau of Energy Efficiency Empanelled Energy auditing firms / cos., (with auditing teams led by Bureau of Energy Efficiency accredited Energy Auditors) or Bureau of Energy Efficiency accredited individual Energy Auditors are only engaged.

i. The report shall contain specific recommendations along with quantitative and qualitative details and outlay, projections of energy / cost savings, payback period etc., upon implementation.

ii. The report should contain, among other things, an executive summary, period of conduct of Energy Audit and specific conclusions and measures / recommendations.

Eligible Enterprises are All existing manufacturing MSMEs in the state which are undertaking energy audit for the first time and MSMEs taking up subsequent energy audit after a period of 3 years.

Quantum of Subsidy is 50% of the Energy Audit cost subject to a Maximum of Rs.0.75 lakh energy audit per unit. Enterprises having more than one unit may also avail this concession, separately for each unit. The overall ceiling on subsidy should be applied

not for the original energy audit and subsequent energy audit taken together, but should be applied separately for the original energy audit and the subsequent energy audit. There should be a gap of minimum three years between the previous energy audit and the subsequent energy audit i.e., present energy audit.

Components Eligible for Arriving Subsidy are the expenditure incurred towards professional charges of conducting an Energy Audit only is eligible.

Eligible MSMEs shall file its claim complete in all respects, within one year from the date of competition of Energy Audit.i. MSMEs shall apply to the DIC / RJD, Chennai of the respective district in the prescribed format-I. ii. The subsidy will be released to the MSME after completion of Energy Audit Report and duly certified by the energy auditor. iii. If the unit availed loan for the purpose of energy audit, the subsidy will be released to the bank to adjust in the loan account if the loan is in currency.

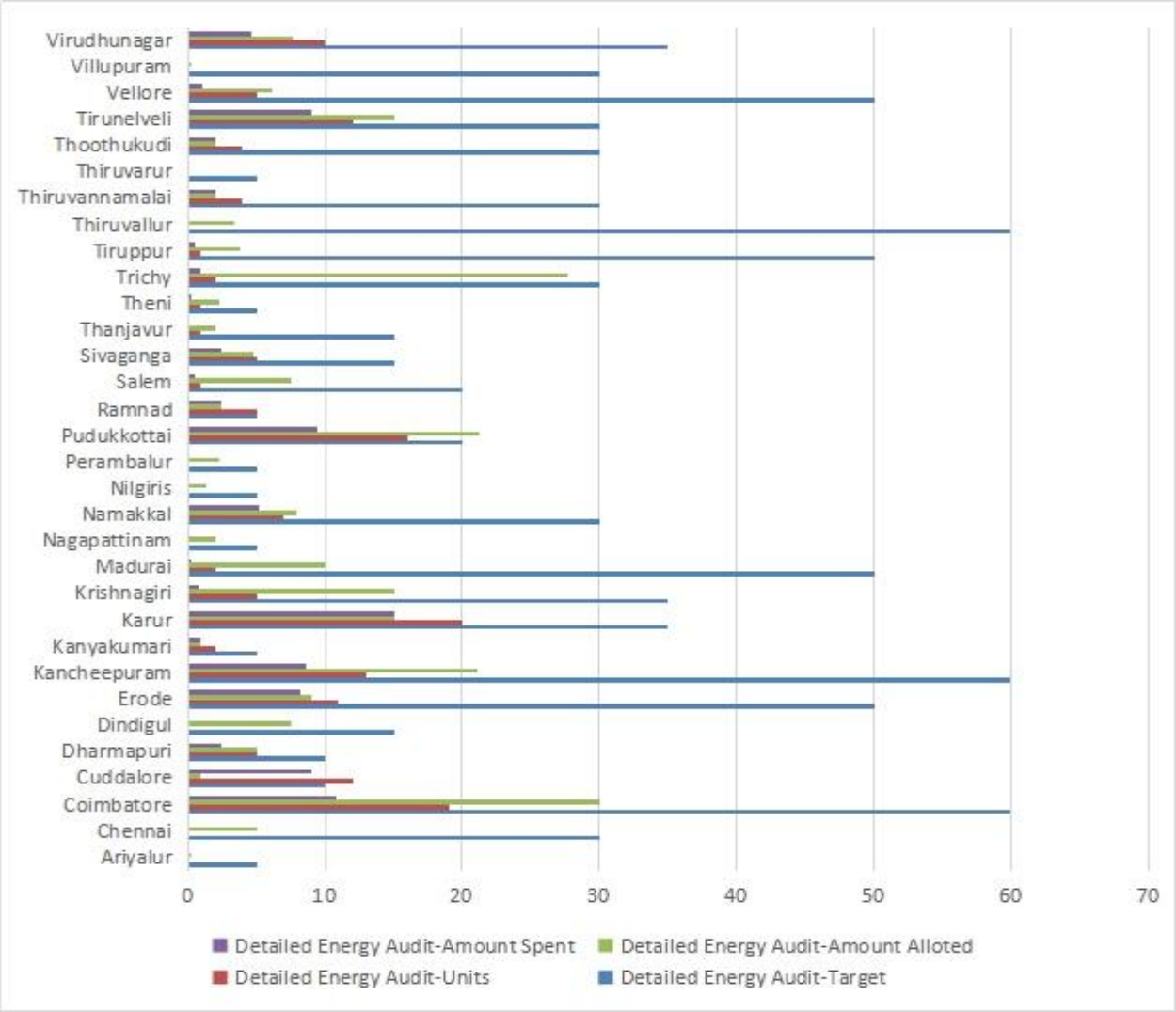

Figure 5: District Wise Performance on Energy Audit

Correlation Analysis

The correlation analysis is given in table 3.

Table 3: Correlation Analysis

	Detailed Energy Audit-Target	Detailed Energy Audit-Units	Detailed Energy Audit-Amount Allotted in Rs. Lakhs	Detailed Energy Audit-Amount Spent in Rs. Lakhs
Detailed Energy Audit-Target	1			
Detailed Energy Audit-Units	0.35	1		
Detailed Energy Audit-Amount Allotted in Rs. Lakhs	0.50	0.56	1	
Detailed Energy Audit-Amount Spent in Rs. Lakhs	0.28	0.97	0.47	1

Table 3 reveals that there is moderate degree of relationship exists between Detailed Energy Audit target and achievement and also the moderate degree of relationship between fund allotted and expenditure on detailed energy audit.

Regression Analysis

The regression analysis is given in equation 1.

EA = 0.8415 + 1.4 E……[3]

Where R^2 = 0.95 and p = 0.00

One unit increase in Detailed Energy Audit Expenditure in Rs. lakhs (E) will lead to 1.4 unit increase in Detailed Energy Audit Achievement (A). Hence Detailed Energy Audit plays a major role in energy efficiency.

5.4 Incentive for Implementing Energy Audit Recommendation

The objective of the scheme is to incentivize MSMEs to implement the recommendations of the Energy Audit Report and to optimize the energy consumption leading to energy saving and money saving in electricity bills.

All manufacturing MSMEs in the state which have undertaken energy audit and have achieved at least 15% energy savings in terms of number of units of energy consumed per unit of product manufactured with reference to last 12 months average.

25% of the cost of the eligible components, subject to Maximum of Rs.2.00 lakh only.

Eligible Components are a. Cost of technology acquired for the purpose of energy saving b. Cost of replacement of energy inefficient equipment / machinery accessories newly purchased and installed. c. cost of modification / alternation made in the existing machinery / equipment / retrofit equipment's.

MSMEs have to apply to DIC / RJD, Chennai only after three months from the date of implementation of Energy Audit recommendations, but within one year from the date of implementation of Energy Audit recommendation.

MSMEs shall apply to the DIC / RJD, Chennai of the respective district in the prescribed format -II. Investments made after the energy audit alone will be eligible for subsidy. The percentage of savings in specific energy consumption (KWh / Kcal per unit product)

shall be reckoned on twelve-month average energy consumption prior to implementation of energy audit recommendation and minimum three month average after the implementation of the recommendation of Energy audit.

The subsidy will be released to the MSME after implementing the recommendations in the Energy Audit Report and duly certified by the energy auditor. If the unit availed loan for the purpose of energy audit, the subsidy will be released to the bank to adjust in the loan account if the loan is in currency.

Ineligible Enterprises are i. All Micro, Small and Medium Service Enterprises. ii. Micro, Small and Medium Manufacturing Enterprises which have availed similar subsidy for the same purpose from any other State or Central Government Department / Agency.

The district wise energy implementation is given in figure 5

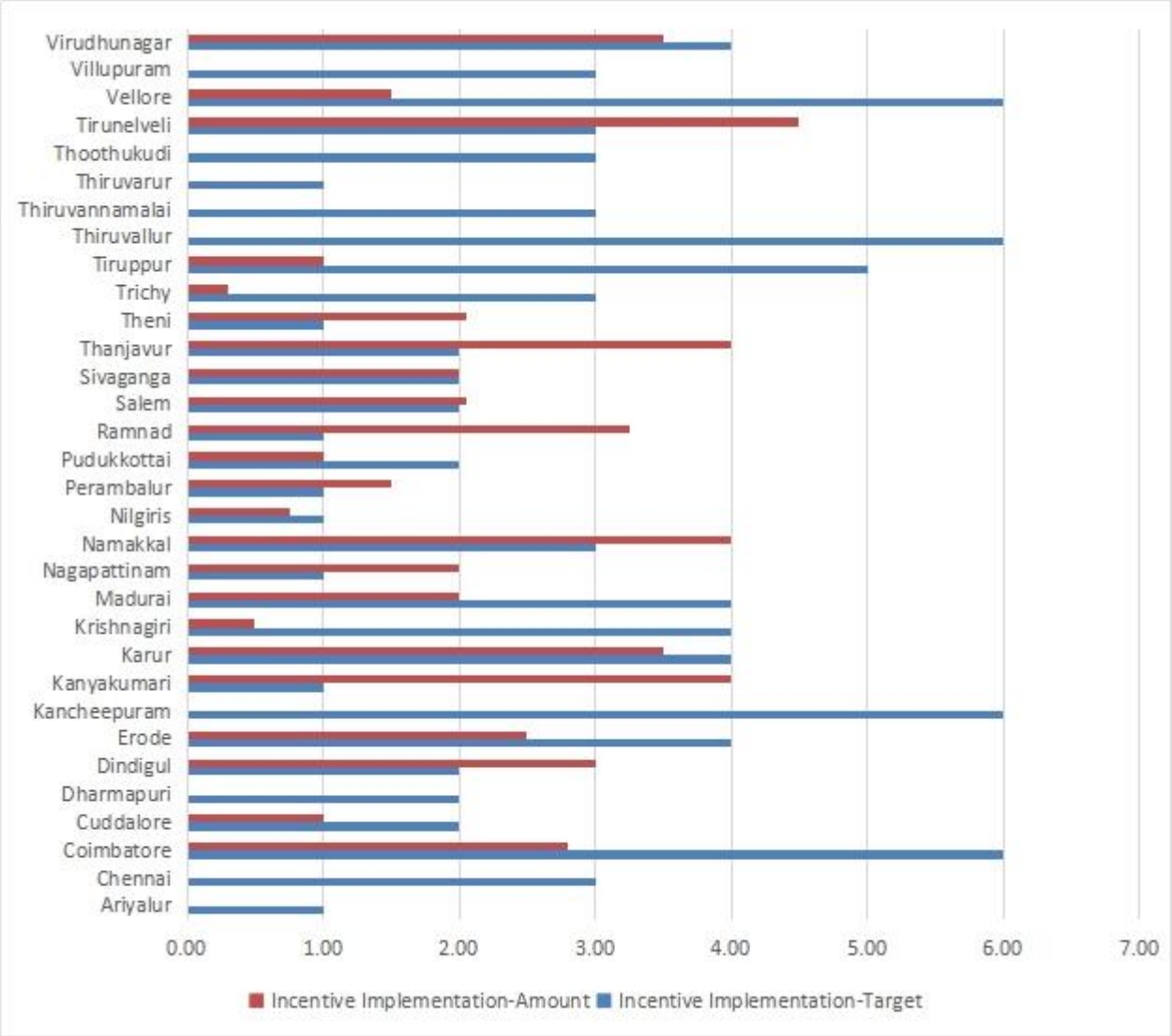

Figure 6: District wise Target and Achievement of Energy Audit Implementation

There is substantial increase in energy audit implementation in Tamil Nadu.

6. FINDINGS, SUGGESTIONS AND CONCLUSION

An attempt has been made to study the performance of awareness programme conducted for MSMEs under PEACE Scheme where awareness camp has been conducted in all districts with achievement on physical and financial target. Hence awareness camp plays a major role in energy efficiency. The performance of training conducted for MSMEs under PEACE Scheme is excellent where Training program has major effect on energy efficiency increase in MSMEs. There is substantial achievement in physical and financial target. The energy audit conducted for MSMEs under PEACE Scheme is also increases and there is substantial achievement in physical and financial target. There is substantial increase in energy audit implementation in Tamil Nadu.

The PEACE scheme achieves SDG goal 7 of Government of India and Tamil Nadu and will have better energy efficiency for MSMEs which will leads to improvement in climate change. To conclude, the Role of Government, Academia and Industry plays a major role in combating Climate Change.

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