

# CLIMATE CHANGE: A THEORETICAL REVIEW

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## ABSTRACT

Climate Change has been undoubtedly the most illustrious environmental issue since late 20<sup>th</sup> century. But neither the discourse merely emerged during that time, nor it was problematized in the same way since its onset. History of Climate Change discourse reveals that from a purely scientific concern it has turned into a public agenda that is nowadays more inclined to be development problem. Transformations have brought about a complete new paradigm every time. This article presents a theoretical analysis of the Climate Change discourse and to do so it captured the underlying philosophy of the issue using Thomas Kuhn's well-known thesis of 'paradigm shift'. In particular it discusses about the crisis that lead the issue towards transformations; explores key perspectives around the crisis thus representation of the issue in the environmental discourse over the time. While this paper establishes that with the beginning of the 21<sup>st</sup> century, the discourse entered into a new paradigm and will reach to a critical point by the end of 2012, it finally postulates some measures that the discourse might integrate with the existing to advance beyond that point.

## KEY WORDS

climate change, anthropogenic, eco-centric paradigm, anthropocentric paradigm, post-Kyoto

## CLASSIFICATION

JEL: Q54, Q56

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## **INTRODUCTION**

‘Climate Change’, the most uttered environmental term of present time has been used to refer to the change in modern climate brought predominantly by human being. It is perhaps one of the most serious environmental issues that today’s world population facing [1-3] though the issue is not new [4]. Ever since it emerged in the early nineteenth century, upto late twentieth century the issue was a topic discussed exclusively within the scientific society [4, 5]. In the mid to-late 1980s it first emerged on the public agenda [5, 6]. Since then, in one hand, it has been manifested by the believers that consequence of human activities on world climate has reached to an alarming state and posing critical threats to physical, socio-economic structures. On the other hand, the sceptics have presented fairly enough evidence to disqualify the anthropogenic trait of Climate Change. Again, the Climate Change advocates among them have debated over the appropriate methods of addressing the eminent issue. Thus with increasing public involvement in the Climate Change discourse and ensuing awareness regarding the potential risks and uncertainties attached to the issue, it has been debated and problematized from diverse standpoints.

While there has constant debate over the degree and agent of the change, methods to address the emerging risks but no doubt and debate over the fact that climate has been changing from the very beginning of the Earth’s history [7]. How has this ever changing climate encountered this anthropogenic attribute over the time? In quest of the answer, the second part of this paper presents a brief definition of Climate Change and the way of manifestation of the issue in the environmental discourse over time. History of Climate Change discourse displays shift in angles from which the issue has been characterized and addressed time to time [4]. Hence the third part examines the key perspectives of Climate Change and the assumptions that lie behind them as they relate to the larger debate surrounding the issue. This part in other words, attempts to analyze the philosophical background of the Climate Change science. The final part presents some hints perceived based on the analysis of problems in a new paradigm.

## **AIMS AND OBJECTIVES**

This paper aims to present an overview of the trend of the Climate Change issue in broader environmental discourse. To achieve this goal, the specific objective of the article is to analyse the history of gradual manifestation of the issue and predict a future path of the prominent discourse.

## **MATERIALS AND METHODS**

The paper approached to achieve the objectives and aim through review and careful consultation of relevant journal papers, periodicals, books, international policy regimes, websites and papers of different agencies. However, there is a big group of Climate Change sceptics who deny the anthropogenic Climate Change, this essay didn’t incorporate that stream of this discourse rather focuses on the stream boosted by the Climate Change believers. This is due to the author’s contention that the perspective led by the believers make the issue survive and progress hence it’s rational to discuss about this only.

To analyze the issue theoretically the paper has framed the overall Climate Change discourse through Thomas Kuhn’s [8] ‘Structure of Scientific Revolutions’. Through this, he, against the conventional ‘uniformitarian’ conception of scientific progress as a continuous process of stockpiling facts and techniques, suggested a ‘catastrophist’ view that the process has been subject to periodic breakdowns and changes of direction [9]. While Kuhn [8] argued instead of linear accumulation of new knowledge, progression of science had gone through periodic

revolutions, he suggested three distinct phases of science: ‘pre-science’, ‘normal science’ and ‘revolutionary science’. ‘Pre-science’ comes first, and it lacks from a central paradigm. ‘Pre-science’ is followed by ‘normal science’ when the practitioners community by ‘puzzle solving’ approaches to enlarge the central paradigm. When this paradigm becomes successful it solves unprecedented problems. Then on building up of some anomalous results, science reaches to a ‘crisis’. At this point a new paradigm is accepted that incorporates the old results along with the anomalous results into a single framework. This he characterized as ‘revolutionary science’. However, Kuhnian thesis of emphasised role of paradigm and paradigm shifts in the evolution of the natural sciences has been regarded as one of the most influential contribution in 20<sup>th</sup> century’s philosophy of science, it has been increasingly applied in social science since its advent [10]. While Kuhn’s work has greatly influenced social science, for instance, in shaping up ‘postmodernist’ view, Kuhn and Weaver [10] noted that economics offered the greatest potential for the fruitful application of Kuhn’s scheme among the social sciences. Scholars like Gordon [11], Coats [9] has directly used Kuhn’s work in economics to analyze its structure of development.

Analysis of the history of Climate Change discourse suggests it has been spread over three centuries and it had seemingly has gone through transformations over the time. The transformations regarding the central perspectives around the issue has time to time shaped up the investigations and addressing measures. Hence to capture a philosophical overview of the development of the subject under scrutiny i.e. Climate Change, the paper devised its research based on Kuhn’s ‘Structure of Scientific Revolutions’.

## **CHARACTERIZING AND HISTORICIZING CLIMATE CHANGE**

Literally ‘Climate Change’ denotes to long-term change in the statistical distribution of weather patterns (e.g. temperature, precipitation etc.) over decades to millions years of time. Climate on earth has changed on all time scales even since long before human activity could have played a role in its transformation [7]. But UNFCCC [12] 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"*. However, the IPCC definition of Climate Change includes change due to natural variability alongside human activity [13]. Australian Government’s DCCEE [14] in its website described Climate Change- *‘our climate is changing, largely due to the observed increases in human produced greenhouse gases. Greenhouse gases absorb 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’*. Thus in the environmental discourse different stakeholders have characterized Climate Change as mainly the change in modern climate augmented by human activities. And the adverse human activities for example burning fossil fuel, deforestation etc. are considered likely to bring change in some climatic aspects which are briefly presented in the Table 1. Also while talking about Climate Change, these are the features that the term mainly entails.

The term Climate Change however through definitions, policy propagation qualifies as a negative anthropogenic Climate Change in its present meaning, at the onset it did not really appreciated its harmful brunt [4]. The discourse is believed to be started by French mathematician and physician Jean Fourier in 1824 when he described greenhouse effect that’s in fact in the core of the climate debate, in his article published at the ‘Annales de la Chimie et de Physique’ [4]. About half a century later Arrhenius [17] published first calculation of global warming from human emissions of CO<sub>2</sub> though Keeling was the first to measure accurately CO<sub>2</sub> in the Earth’s atmosphere in 1960 [18]. Vlassopoulos [4] notes that

**Table 1.** Aspects of Climate Change and perceived implications.

Climatic Features		Implications of Change
Global Warming	GHG concentration	Emission of Green House Gases thorough industrialization, travelling etc. is increasing the GHG concentration in the atmosphere. At this moment CO <sub>2</sub> concentration is at its highest concentration <sup>1</sup> in 650 000 years – 393 ppm [15]
	Change in world temperature	GHG concentration along with some other issues leads to warming the world. Earth has warmed since 1880. Most of this warming has occurred since the 1970s, with the 20 warmest years having occurred since 1981 and with all 10 of the warmest years occurring in the past 12 years [15]  Being central to the issue predominantly, Global warming brings about change in following different features of the human environment
Ozone layer depletion		A slow, steady decline of about 4 % per decade in the total volume of ozone in Earth's stratosphere (the ozone layer) since the late 1970s is estimated [16] 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 150 km <sup>3</sup> to 250 km <sup>3</sup> (36 mi <sup>3</sup> to 60 mi <sup>3</sup> ) of ice per year between 2002 and 2006 and Antarctica lost about 152 km <sup>3</sup> (36 mi <sup>3</sup> ) of ice between 2002 and 2005 [15]. This on the other hand contributing to the next problem sea level rise.
Rise in Sea Level		Global sea level rose about 17 cm (6,7 in) in the last century [15]. Continual increase is very likely to inundate many island states, low-lying delta regions leaving their population having no land to inhabit.
Ocean Acidification		Since 1750 the CO <sub>2</sub> 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 % [15].
Warming Oceans		With the top 700 m (about 2300 ft) of ocean showing warming of 0,16 °C since 1969 due to absorbed increased heat of the Earth [15]. These two changes are likely to bring massive change/destruction in ocean habitations.

climatic variations were perceived precisely as a scientific issue until 1970, hence the debate was mostly confined to the scientific community of climatologists and relevant research was fragmented into different university endeavours only.

AIP [19] maintains that the rise of environmentalism in the early 1970s raised public doubts about the benefits of human activity for the planet which in other way turned the curiosity about climate into anxious concern. Since then concern about anthropogenic global degradation spreads which ignited numbers of international cooperation, programs and meeting to date of concerned stakeholders including representatives from interested community other than the scientist only [4, 19]. Programs and meetings in 70s appear to take place to explore and acknowledge the extent of anthropogenic Climate Change. Global Atmospheric Research Program (GARP) organized by World Meteorological Organization (WMO) and the International Council of Scientific Unions (ICSU) in 1974 is an example in this regard. It was aimed to examine the highly complex problem of the physical basis of

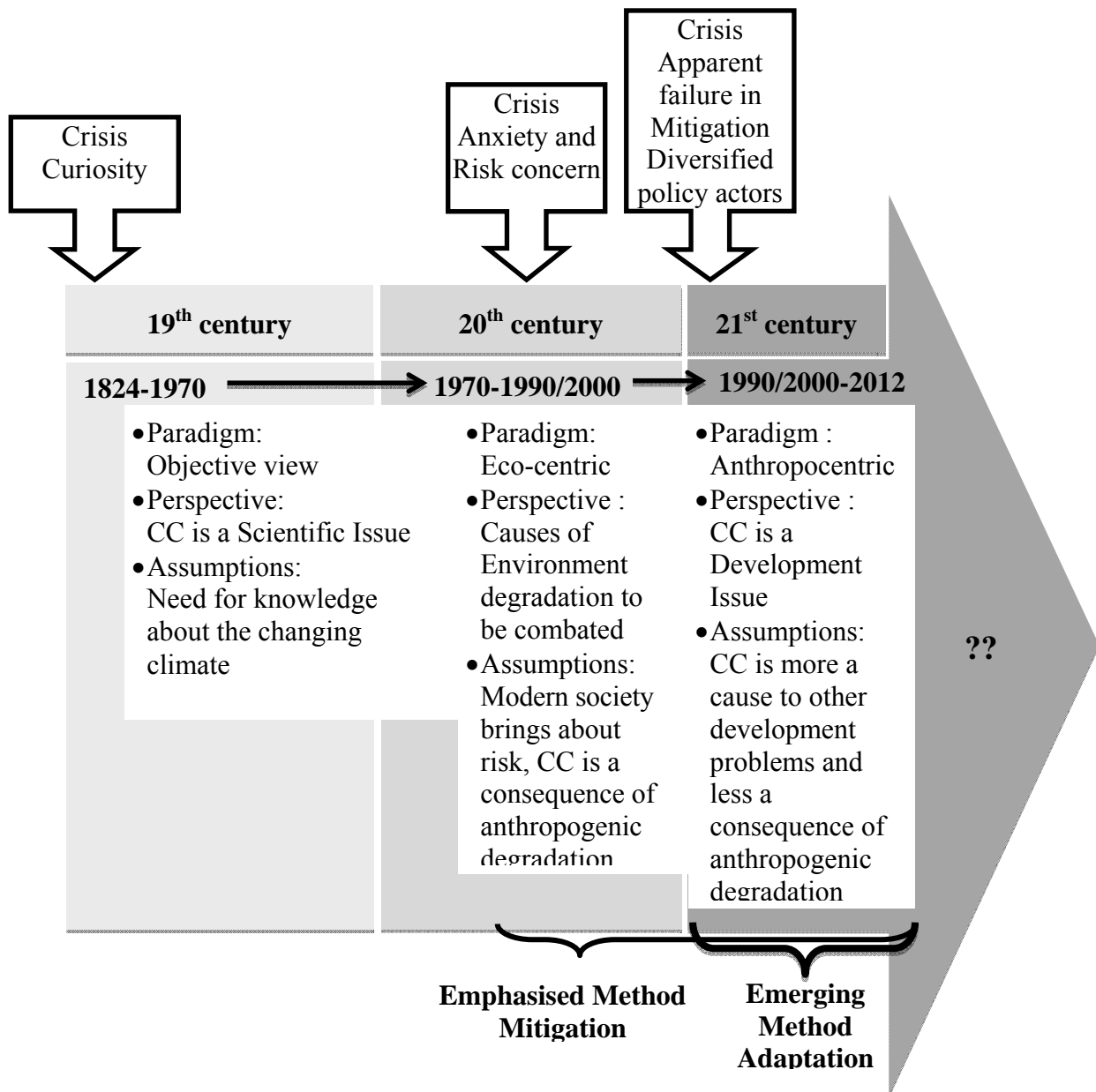
climate [20]. Another example could be the first World Climate Conference (WCC) organized by the WMO in 1979. Whereas, some significant events in 1980s and 90s, can be said, were inclined to devise methods to address it. For example, Montreal Protocol of the Vienna Convention in 1987 imposes international restrictions on emission of ozone-destroying gases. Two major events in 1990s, one, '92 conference in Rio-de-Janeiro produces UN Framework Convention on Climate Change and another '97 International conference produces Kyoto Protocol (came into effect in 2005) that set targets for industrialized nations to reduce greenhouse gas emissions [18]. Kyoto Protocol is regarded the most significant commitment in addressing Global Climate Change so far. That's why as it expires at the end of 2012, through different conventions, from UNFCCC to the latest Conference of the Parties (COP-17) to the convention, held in November–December 2011 in Durban, South Africa, the world nations are continuing to strive to negotiate what may become the post-Kyoto [21].

## **KEY PERSPECTIVES AND ASSUMPTIONS IN CLIMATE CHANGE DISCOURSE**

While Climate Change discourse has been spread over three centuries it encountered some crisis resulting from perspectives of the concerned community (e.g. scientific) of the time based on relevant assumptions. This triggered investigations, following research knowledge had been gathered and established in the society that became the normal science. Later following counter perspectives there arose crisis again and a shift in the normal science accordingly which prevailed for a period again and thus the discourse goes on with revolution of the established normal science. Drawing upon the historicization in the earlier part of the essay and review of other related literature, I would like to suggest that Climate Change discourse so far belonged to three different paradigms, each changed with development of certain perspectives based on relevant assumptions<sup>2</sup> (Fig. 1). The period before the first 'crisis', can be described as the 'pre-science' period as per Kuhn [8].

The first 'crisis' that begins the climate study can be said 'lack of knowledge about the changing climate', in other words it was 'curiosity' about the climate as noted by AIP [19]. Hence, FoE [22] suggestion for Benjamin Franklin as the pioneer of the discourse (as he started climate studies in the 1763) seems more likely to me, following that crisis. However, Weart [18] and Vlassopoulos [4] suggest the beginning of the discourse in 19<sup>th</sup> century by Fourier. Notwithstanding this debate, from the very beginning investigation into Climate Change science being driven by 'curiosity' or 'in pursuit of Climate Change knowledge', very rationally attracted exclusively the scientific society in particular the climatologists till the next crisis in 1970's. The study of increased CO<sub>2</sub> emissions, and the effects of burning coal to the earth's temperature by Arrhenius, later Fourier did not appreciate its negative impact. It demonstrated that during this time Climate Change belonged to a state guided by an 'objective view' (neutral to any Eco-centric or Anthropocentric view) shaped by the notion that it was completely a scientific issue [4].

Climate Change discourse in modern era (precisely from 1970s) confronted crisis that portrayed through the public doubts about the positive outcome of human activity for the planet that was augmented by rising environmentalism [19]. This, AIP [19] noted, transformed the society's 'curiosity' into 'anxious concern'. The modern society has been characterized as the 'risk society' [23] where Sociologists recognized anxiety about high consequence risks (e. g. global warming) as major theme of it [4]. Hence the transformation was a viable reflection of modern society. This crisis leads towards wider participation of stakeholders and inclusion of societal perspective along with scientific view in the discourse [4]. For example, Global Atmospheric Research Program (GARP) of 1974. Though it was entirely



**Figure 1.** Structure of revolution of the Climate Change discourse.

a scientific meeting, the participants were experts ranging from climate scientists to researchers on energy, land use or water resources. Ausubel [24] noted that the meeting specifically focused on the effects of climatic hazards for developing countries and the potential of greenhouse effects to question the sustainability of the industrial civilization. 1979s World Climate Conference (WCC) is believed to be the first to give a clear definition of human induced Climate Change as a major environmental problem which also identified Climate Change as an autonomous public problem to be addressed by the establishment of environmental policies [4]. This paved way for World Meteorological Organization (WMO) and United Nations Environmental Program (UNEP) to be the main institutional actors in the arena while the first one insured the scientific expertise and the second one insured the policy expertise [4]. This situation, Vlassopoulos [4] notes, placed emphasis on the *cause of Climate Change*, in particular, global warming and ‘*Mitigation*’ measures as addressing method. Kyoto Protocol is an example of this trend which was meant to be setting binding targets for industrialized nations. Vlassopoulos [4] however agreed that Kyoto Protocol and UNFCCC did some work on *Adaptation* but it was of minimal importance.

Mee [25] suggested a shift in the debate followed ‘how to deliver Sustainable Development’ rather than ‘how to protect the environment’ in new century following the World Summit on Sustainable Development (WSSD) in 2002. However Vlassopoulos [4] maintains the trend pointed by Mee was prominent in 1970s and 80s, started declining in 1990s after the UN’s 92 Rio-de-Janeiro Conference on Environment and Development. He further notes the term “global warming” was experiencing a gradual definitional shift since 90s while it was moving *from* an autonomous environmental problem whose causes (particularly CO<sub>2</sub>) must be combated *to* being discussed as the cause of other global public problems that are threatening humanity’s wellbeing. According to him this considers Climate Change less as one of the consequences of anthropogenic environmental degradation and more as one of the causes of other major problems e.g. development, migration, security etc. [4]. This implies, while the previous period (1970s-80s) climate change was analysed as a physical process within a normal scientific paradigm belongs to an ‘Eco-centric’ paradigm, the later part till date belongs to an ‘Anthropocentric’ paradigm. The crises triggered the change in paradigm could be recognized as: lack of commitment by certain big GHG-emitter countries or failure in achieving the set target for Mitigation, the inappropriate application of the emissions trading system and a growing diversity of the policy actors who are approaching the issue with their own management [4].

## **CLIMATE CHANGE IN A NEW PARADIGM**

Although the shift in the global perspective brought about a paradigm shift in Climate Change discourse recently in the new millennium, the discourse in post 2012 is deemed to face some crisis. Those might not challenge the status quo of the paradigm but will require significant adjustment in relevant policy making.

First, due to the definitional shift or change in perspective (from Climate Change as a cause of Environmental degradation to Climate Change as a development issue), a diverse range of public authorities are coming into managing Climate Change problem. Vlassopoulos [4, 26] noted different dimensions of this incorporation of diverse public authorities in policy making of a problem like Climate Change. He maintains while it is more about legitimization of the concerned authority’s footing, power in the arena, the definition or characterization of the problem and the policy measure comes according to the specific authority’s view. For example, a scientific authority would find the cause GHG emission and other natural phenomena creating ‘Climate Change’ problem and the consequence is environmental degradation including drought, sea-level rise, extreme weather events etc. whereas a development organization would perceive Climate Change and the relevant degradation as the cause of the problem ‘underdevelopment’ which is resulting into hunger, poverty disaster risk etc. [27]. Hence different structure will articulate its own rationale of victimization and responsibility attribution and this along with leading to different policy solutions will also influence the recognition of authority to one or another policy sector [4]. Without a common framework to articulate relevant policy it would be difficult to proceed on a time beyond Kyoto Protocol.

Second, manifold problems around further ‘Mitigation’ measures subsequent to the end of Kyoto Protocol in 2012 are being anticipated. While Kyoto Protocol was appreciated as an acceptable or good first step by some scholars [28, 29], it was “Deeply Flawed” an agreement to many of the analysts [30-32] due to its ambitious targets applying only to a very short term (2008-2012) and merely to some industrialized nations [21]. Hence any post-Kyoto ‘Mitigation’ mechanism need to take in account the criticisms that Kyoto Protocol faced in order to establish an effective ‘Mitigation’ measures. This is further essential in order to

address the scientific consensus regarding the likelihood of future Climate Change caused by already grown anthropogenic emissions of GHGs since the negotiation of the Protocol [33, 34].

Third, the significant method to address Climate Change so far has been ‘Mitigation’ considering ‘Adaptation’ as a less important one that has been mentioned earlier, but some authors e.g., Parry *et al.* [35] maintained that ‘Mitigation’ and ‘Adaptation’ are complementary to each other. For example, Ingham *et al.* [36] argued that greenhouse gas mitigation reduces the speed of global Climate Change, so that societies can gain time through investing in ‘Mitigation’ which in turn can reduce the costs of ‘Adaptation’. Backstrand and Lovbrand [37] noted climate ‘Mitigation’ and ‘Adaptation’ has been represented as parallel processes in the IPCC’s fourth assessment report that more and more puts stress on development and ‘Adaptation’ needs and attempts to redress the climate problem in a more locally oriented Sustainable Development theme. Thus a growing support for considering ‘Adaptation’ as a method of similar importance following the Anthropogenic paradigm in the Climate Change discourse has already been launched through different initiatives. But as a matter of fact despite the growing acceptance of ‘Adaptation’ as the second pillar of climate policy there is no change in post-Kyoto negotiation institutional framework to appreciate the change [4].

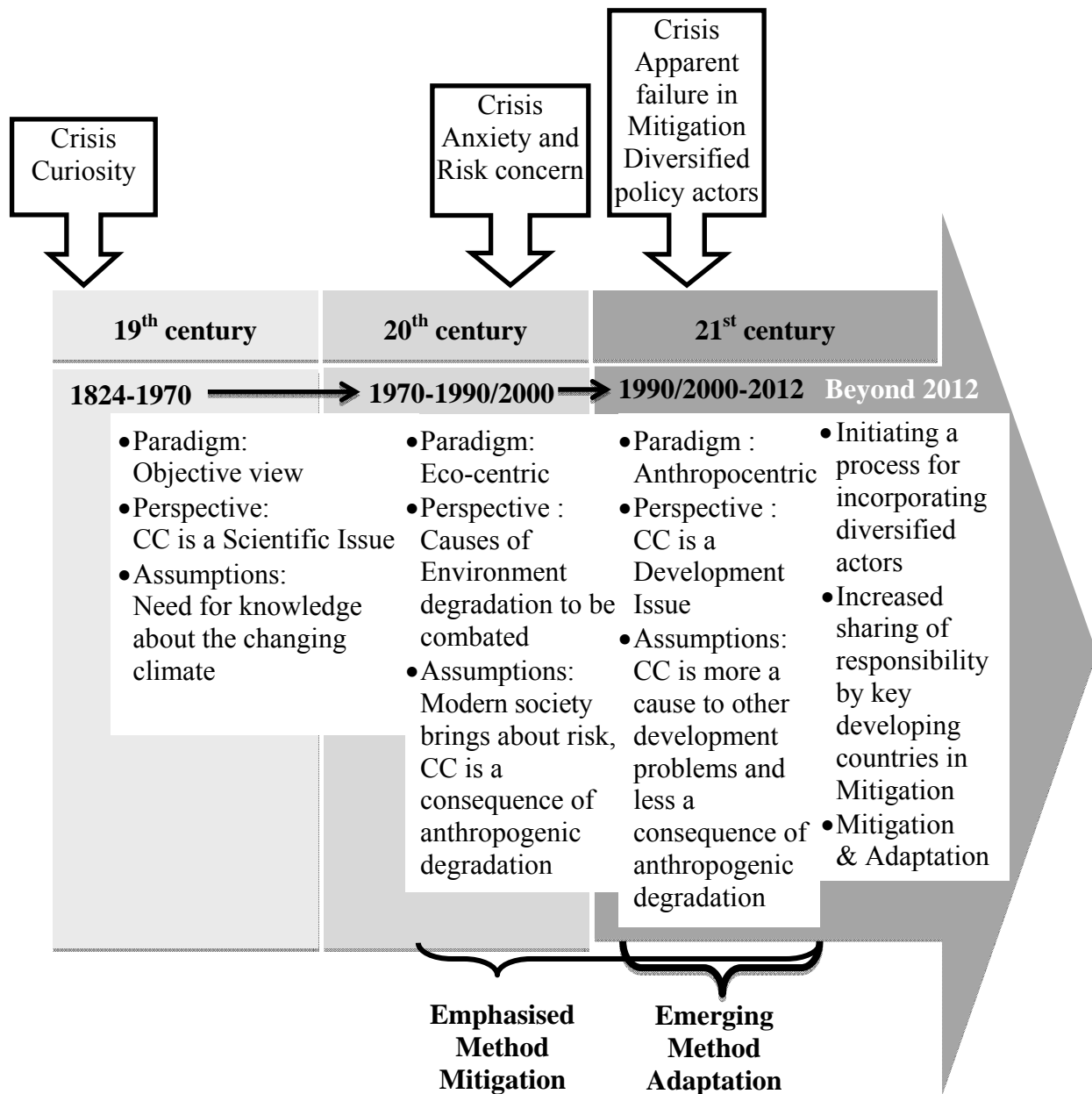
In the face of these challenges the paradigm is envisaged to advance beyond 2012 successfully with incorporation of some initiatives and rearrangement<sup>2</sup> (Fig. 2). First of all, it needs to destabilize the status quo of existing international and national environmental actors in policy making who tend to incorporate the new development, impact-adaptation dimensions into their administrative structures to reconfirm their institutional leading position in Climate Change field. Instead of that, a process should be initiated (probably like the ‘UN system delivering as one’ which is aimed to achieve a coordinated action-oriented approach to the global and multifaceted challenge of Climate Change) to engage the new actors brought on stage by the new paradigm [4].

Ending of Kyoto Protocol’s timeframe is not only posing an uncertainty, reflecting positively, it will create scope for wider and deeper international participation to address the global nature of the climate problem as well as the weaknesses of the Kyoto Protocol [21]. To ensure this Olmstead and Stavins [21] suggested a key element to be present in any post-Kyoto negotiation that is *a framework to expand participation to ensure that the most important industrialized and developing nations are involved in meaningful ways.*

Expanded participation in emission cutting specially including the key developing nations is very necessary to make an effective negotiation. If not earlier, by the year 2020 the developing countries are likely to account for more than half of global emissions [38-40]. Only China emitted 8 % of global anthropogenic CO<sub>2</sub> in 1981 and about 21 % by 2008 [41, 42]. Hence, emerging economies, particularly China, India and Brazil, should engage to limit their carbon footprints [21]. Other than this reason, developing countries are also in a favoured position to cut emission as they provide the greatest opportunities for low-cost emissions reductions [30].

This expanded participation is likely to bring twofold advantage: first, likelihood of endorsement a new binding target by US as promised will be done on bringing the key developing nations under binding target [21], and second, it could augment the ‘Adaptation’ process. Tubiana *et al.* [43] argued that the developed countries accepted to consider the ‘Adaptation’ demands coming from developing countries were founded in a win-win compromise, developed world will be willing to mobilize enough resources for ‘Adaptation’ if the developing side offers something significant in exchange. To continue with an emphasis on ‘Adaptation’ alongside ‘Mitigation’, hence, it requires a wider participation to be ensured.





**Figure 2.** Structure of revolution of the Climate Change discourse with proposed measure beyond 2012.

## CONCLUSIONS

The analysis of Climate Change discourse shows that the issue from its initial perspective of ‘an entirely scientific issue’ moved to be the cause of ‘Environmental Degradation’ and finally in recent time has turned something much larger and going beyond environmental degradation (Vlassopoulos [4] quotes a personal interview with one UNDP representative, 2010). The change or transformation of the underlying philosophy around the issue has been occurring due to confrontation with newly emerged perspectives among the concerned community. Every time a revolution in the existing philosophy is evident (Fig. 1). Thus, based on the trend, it is anticipated that in the new millennium the shift in the concern from environmental degradation to human wellbeing in other words ‘Eco-centric’ to an ‘Anthropocentric’ paradigm is expected to be continuing with a number of correcting measures (Fig. 2) like inclusion of diversified actors, increased responsibility of pertinent

developing nations in mitigation target instead of differentiated responsibility and equal emphasis on mitigation and adaptation.

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## REMARKS

<sup>1</sup>Data has been collated from the 'Home' section of the referred website.

<sup>2</sup>Developed by the author based on literature referred in the 'Key perspectives & assumptions in Climate Change discourse' section.

<sup>3</sup>Modification conceived based on review of materials referred in 'Climate Change in a new paradigm' section.

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## **KLIMATSKE PROMJENE: TEORIJSKI PREGLED**

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### **SAŽETAK**

Klimatske promjene nesumnjivo su najuočljivije potanje o okolišu od kraja XX. stoljeća. Ali niti je diskurs nastao tijekom tog vremena, niti je razmatran na isti način od nastanka. Povijest diskursa klimatskih promjena pokazuje kako se taj diskurs od znanstvenog pitanja pretvorio u javnu agendu koja se danas najviše razmatra kao pitanje razvoja. Pretvorbe su svaki put dovele do potpuno nove paradigme. Ovaj rad predstavlja teorijsku analizu diskursa klimatskih promjena, zbog čega su obuhvaćeni filozofski temelji u vidu pojma promjene paradigme T. Kuhna. Posebno, razmatraju se krize koje su prethodile pretvorbama diskursa, istražuju glavna stajališta o krizama i shodno tome predstavljanja teme u diskursu okoliša tijekom vremena. Prema ovom radu diskurs je na početku XXI. stoljeća ušao u novu paradigmu i dostigao kritičnu točku krajem 2012. godine. Rad naposljetku postulira mjere koje diskurs treba uključiti kako bi se i nadalje razvijao.

### **KLJUČNE RIJEČI**

klimatske promjene, antropogeno, ekocentrična paradigma, antropocentrična paradigma, post-Kyoto