Adaptation as a Response to Climate Change: A Literature Review

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Abstract

Climate Change is one of the biggest challenges the human race is being encountered in this centaury. The continuous rise in average temperature, extreme weather occurrence, occurrence of drought and floods, intensity and frequency of storms, change in precipitation, and so many other identified and unidentified effects are giving birth. In upcoming years, the climate change would be more severe and challenging, and as a result, it would fetch the attention of whole world towards itself. In this scenario, the different policy options and techniques evolved to cope the climatic changes and its effects on society, economy and nature. The lack of response of carbon emitters in mitigation has aid to raise temperature continuously. This time adaptation is getting more and more attention to reduce the socio economic vulnerability and risks associated with the climate change. Adaptation is unavoidable. This paper enumerates the literature review of Adaptation. Although this term is not new but it has been focused in last few years as one of the key responses to climate change. How and why adaptation is necessary and its implications in coping the climate change challenges and what progress has been made in past and present.

Key Words: Climate Change, Adaptation, Mitigation

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1. Introduction

There is no doubt for long time the researchers have been working on this issue by forwarding and suggesting different options to prepare this challenge in advance and keep it away as long as possible. Intergovernmental Panel for Climate Change (IPCC) is working with the funding of U.N and member countries. United Nations Framework for Climate Change (UNFCC) having member countries all around the world. UNFCC has one protocol called Kyoto Protocol, in Kyoto Japan and it has signed by 187 countries except U.S till 2009. IPCC II, 2001 report clearly defined and enumerates the increasing importance of Adaptation. COP 13 has established the adaptation fund board with established at COP7. COP 14 at Pozan (2009) made a progress on number of issues concerning to adaptation. UNFCCC (2007) reports a cost of protecting infrastructure from climate change in North America between 1990 $US4 and 64 billion already in 2030, when temperature increase is likely to be far below 2.5°C. The major breakthrough is made in recent Copenhagen Consensus on climate change where Adaptation was declared as the one of the five major responses to the climate change (Bosello *et al*, 2009). Although the comprehensive analysis report is presented in Copenhagen summit 2009, but still there is a lot of space to work on. The governments and developing agencies are now planning the adaptation strategies to face this challenge.

This paper is a literature review of Adaptation to climate change worldwide. The recent development on adaptation has come forth many options to deal with social vulnerability and risks associated with climate change. Adaptation provides basic set of measures to reduce damage and risks caused by the direct or indirect affects of climate change. Previously, most of the emphasis has been laid on mitigation that used as a tool to reduce the emission of carbon. However, the goals set could not achieve the results anticipated as most of the countries' reluctance on binding conditions. The earth temperature continue to rise and affects of climate change on human living increased especially in health, agriculture, coastal settlement and natural ecosystem. It urged researchers and policy makers to explore the adaptation as key policy option besides mitigation. The mitigation and adaptation combined provide the optimal result. The developing nations are in severe need of adaptation to climate change especially those are resource dependent and sensitive to climate change. Mitigation on the other hand is effective in developed countries that emit most of carbon. There is still a gap in

identifying what to adapt and where to adapt and how to get the optimal mix of adaptation and mitigation both.

2. Research Shift to Adaptation to Climate Change

The one of the recent policy options to the response of climate change is "Adaptation" basically this term has been used in the climate change community since the early 1990's. In 1992 United Nations Framework Convention on Climate Change (UNFCCC), addressed both mitigation and adaptation as the key response to the global warming but unfortunately the progress on adaptation has been slow. In 1995 IPCC, working group II released second assessment report on technical analysis of adaptation and mitigation pointing out the uncertainties and further change in global environment. Burton (1992), Smit (1993), tried to explain the adaptation and its characteristics, Klein (1997), Carraro (1998), Leary, Fankhauser and Smith (1999), all these researchers have somehow discussed the adaptation in their work on climate change. Frustration over the lack of progress and effectiveness of policy to reduce greenhouse gas emissions has contributed to this shift (E. Lisa F. Schipper, *et al* 2007). Previously, most of the emphasis was on the policy of Mitigation which was directly concerned to limit the source of the gases, but due to non cooperation when vulnerability became unavoidable, the Adaptation came under consideration. Now over the past few years there has been considerable attention to climate change adaptation in both scientific and popular publications. The major breakthrough made in IPCC (TAR) third assessment report in 2001, where the impacts and the options for adaptation and mitigation were revealed. Since then it has also released other special reports. The forth assessment report IPCC (AP4), 2007 was released in stages. It represents the formally agreed statement of the IPCC concerning the sensitivity, adaptive capacity, and vulnerability of natural and human systems to climate change, and the potential consequences of climate change. European Union has issued Green Papers on Adaptation, (EU, 2007). The regional adaptation action plans have been set up as a response. The healthy decisions were taken in COP13, Bali Action Plan in 2008, where parties reaffirmed to response the IPCC Fourth Assessment Report. It includes enhanced action on adaptation, risk management strategies, disaster reduction, and economic diversification on resilience.

The term "Adaptation" has been defined in different dimensions see, Burton (1992), Smit(1993), Smithers and Smit (1997), Smit et al. (2000), UNDP (2005), EEA (2005), UNFCCC (2006). It's just because of complication lying to the concept, who is adapting what and where. But mostly referred definition is provided by the IPCC 2001[2].Generally adaptation is well recognized as a response to a climate change that are evolved in shape of intense weather conditions, unexpected floods and drought, rising sea level, and their effects on different sectors which increases risks and vulnerability on socio-economic conditions. From a temporal perspective, adaptation to climate risks can be viewed at three levels, including responses to: current variability (which also reflect learning from past adaptations to historical climates); observed medium and long-term trends in climate; and anticipatory planning in response to model-based scenarios of long- term climate change. The responses across the three levels are often intertwined, and indeed might form a continuum. (Adger, Agrawala and, Mirza, 2007).

Although adaptation is not a nascent tool to cope the climate change but it took attention of researchers in recent years keeping in view the increasing socio economic vulnerability due to rapid changing climatic conditions. Therefore, the adaptation is viable. The research and studies are in rudimentary development phase where there is a need.

3. Assessment and worldwide Compensation to Climate change

Adapting to current climate variability is already sensible in an economic development context, given the direct and certain evidence of the adverse impacts of such phenomena (Goklany, 1995; Smit et al., 2001; Agrawala and Cane, 2002). Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic challenges, particularly for those parts of societies dependent on resources that are sensitive to changes in climate (Saleemul Haq, *et al,* 2003). The main focus of adaptation is to reduce the vulnerability and risks associated with the climate change. Adaptation is focused on the social and economic determinants of vulnerability in a development context. All climate-sensitive systems of society and the natural environment, including agriculture, forestry, water resources, human health, coastal

[2] Adaptation is adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. This term refers to changes in processes, practices or structures to moderate or offset potential damages or to take advantages of opportunities associated with changes in climate. (IPCC, 2001).

settlements, and natural ecosystems, will need to adapt to a changing climate or possibly face diminished productivity, functioning and health. In human society, much of adaptation may be planned and undertaken by private decision makers and by public agencies or governments. For humans, adaptation is a risk-management strategy that has costs and is not foolproof. The effectiveness of any specific adaptation requires consideration of the expected value of the avoided damages against the costs of implementing the adaptation strategy (IPCC, 2007; Easterling *et al* ., 2004)

Now researchers are focusing on the combined implementation of mitigation and adaptation which will yield the more positive results. The optimal strategy would be a combination of mitigation and adaptation measures (.Kane and Shogren 2000; McKibbin and Wilcoxen, 2004). The ultimate question policy makers are interested in is how to reduce the climate-change vulnerability of socio-economic systems in the most cost- effective way. This can be done both through mitigation and adaptation. However, Adaptation and mitigation are both viable strategies to combat damages due to climate change; they tackle the problem from completely different angles. This is not necessarily so with adaptation: its smaller scale and the excludability of its benefits can spur also a unilateral effort (Bosello *et al*, 2009). The effects of mitigation and adaptation occur at different times (Wilbanks, 2005; Klein *et al.*, 2003; Fussel and Klein, 2006).

In order to evaluate the best possible results, the emphasis has been laid to implement the adaptation and mitigation combined for optimal benefits (IPCC, 1995). The basic differentiation between adaptation and mitigation reveals when it comes to the results and outcomes. Mitigation is constrained by "long-term climatic inertia", while adaptation by a "shorter-term, social-economic inertia", mitigation provides a "global", whereas adaptation provides a "local" response to anthropogenic climate change (Bosello *et al*
2009). The policy diversification is different for both the concepts and its implementation would also need to address the effective paradigm. But the question of analyzing the real damage, the location, calculation of risks and vulnerability is still a question. Who is going to decide and for whom? It is worth mentioning that mitigation involves decision making at the highest level, i.e. national governments, is implemented at the country level (Tol, 2005), while in case of adaptation needs to be implemented at an atomistic level involving a much larger number of stakeholders.

Thus, at least in principle, the design of an international policy effort could be easier - and the related coordination and transaction costs lower - for mitigation, than for adaptation. Mitigation and adaptation work at different spatial and time scales. Mitigation is "global" and "long term" while adaptation is "local" and "shorter term" (Klein *et al.*, 2003; Fussel and Klein, 2006; Tol, 2005; Wilbanks, 2005, Ingham *et al.* 2005a). In order to calculate and asses the joint analysis of mitigation and adaptation AD-WITCH and IAM (Integrated Assessment Model) are designed. This design suggest the assessment of Adaptation and Mitigation combinely and separately ((Bosello *et al* 2001).

The resource dependent societies are more vulnerable and adaptation helps to diminish their sensitivity to climate system in various areas. In this scenario does mitigation and adaptation both be undertaken simultaneously? Obviously not everywhere, as it is very difficult for the developing nations due to huge cost and lack of technology availability. Adaptation singly reveals the benefits at regional level and ought to be more effective where damage and risk of vulnerability is very close and unavoidable. It works as the first aid in that scenario. However, there is need of more comprehensive tools of assessing the risks and damage in order to identify the right choice to cope the situation.

4. The Policy Implications to Individual Nations

Climate change doesn't have similar effects all over the world, its implications varies place to place, region to region and sector vise for Example; Impacts on agriculture vary a lot with the climatic conditions of the regions and become positive for cold or mild regions (e.g. Russia, China). Similar pattern can be identified for impacts on energy use, with cold regions being more positively affected *i.e.* Russia.

Adaptation is particularly needed in developing countries which are either more exposed or vulnerable[3] to climate change (IPCC, 1996; IPCC, 2001, IPCC 2007). As mentioned earlier, the problem that confuses more to the policy makers and researchers is cost. Both the policy options need cost and it is very difficult especially for developing countries to meet this solely. This is the limitation; the policies are less effective in poor and countries with less

[3] High sensitivity and lower capacity to adapt

literacy rate. The different spatial effectiveness of adaptation and mitigation is also relevant in the light of "spatial uncertainty" of climate change damages (Lecoq and Shalizi, 2007). Adaptation in developing countries thus calls objectively for strong international support.

In summary, Adaptation can be identified along three dimensions:

- the subject of adaptation (who or what adapts)
- the object of adaptation (what they adapt to)
- the way in which adaptation takes place (how they dapt).

All dimensions works in the major areas of human health, coastal area and sea rise level, agriculture and forestry, ecosystem and wildlife, water resource and, energy. Like in human health, many diseases and health problems that may be exacerbated by climate change can be effectively prevented with adequate financial and human public health resources, including training, surveillance and emergency response, and prevention and control programs Urban tree planting to moderate temperature increases Weather advisories to alert the public about dangerous heat conditions Grain storage, emergency feeding stations Adjusting clothing and activity levels, increasing fluid intake (*EPA, 2009*)

Furthermore, as a policy response three components of adaptations have been identified keeping in view the geographical and socio economic conditions of regions;

1) Anticipatory Adaptation
2) Reactive Adaptation
3) Innovative Adaptation

In OECD countries most resources are devoted to anticipatory adaptation, whereas NON-OECD countries spend more in reactive adaptation (Bosello, *et al* 2009). Every component is needed to be implemented after extensive analysis of nature of damage and vulnerability keeping in view the cost benefit ratio.

The recent literature points to the large potential damages from climate change, especially on developing countries and on non-market sectors (IPCC, 2007; Stern, 2007). Literally it concludes that the nations highly dependent on natural resources and representing the developing world would be highly affected. Sector wise highest risks are

apparent in agriculture, fisheries and many other components that constitute the livelihood of rural populations in developing countries (W.Neil, Saleemul Haq, *et al* 2003) Developing countries are dependent on climatic resources and because of growing populations and lower technological capabilities, they generally have lower adaptive capacity (Downing 1997, Magistro and Roncoli 2001). The optimal response to climate change entails both mitigation and adaptation measures. The adaptation mix consists of different strategies and such mix is region specific. In People of developing nations are not passive victims. Indeed, in the past they have had the greatest resilience to droughts, floods and other catastrophes (W.N. Adger *et al* 2003).

There is no doubt the developing countries are the foremost victims of climate change and highly effected stakeholders in term of development race. The policy options are limited to them due to resource dependence in growth and resource constraint to climate change. As a result they posses more adaptability power than that of rest but need to be acknowledge of possible risk and vulnerability.

5. Conclusions and Perspectives

First, the research orientation to Adaptation to climate change has been separately focused since past few years. Now, there is a need of addressing adaptation as prioritized policy option in more optimistic way and need more extensive research to unveil the effective means and ways to implement. Secondly, there is need of international institution to asses and identify the risks and damages as to choose the correct policy option and action plans. Thirdly, besides its combined implementation with mitigation, adaptation is capable to deal the climatic conditions alone where nations are reluctant to binding condition of mitigation. Fourth, the economic based options must be considered with technological based options, which may reduce the cost. Fifth, there is need of strong financial and economic co-operation between the countries of the world, regardless of group and categories. Finally, adaptation is more important for the developing countries where developed countries follow the mitigation to reduce the carbon emission. The future studies may occur in the context of the overhead budget for the adaptation cost tracking in seeking consensus of a better world.

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