

Executive Summary

The Climate Challenge

Climate change is the daunting challenge of the times. An effective engagement with the anthropogenic global warming problem involves a paradigm shift in the framework of international co-operation so far. The 2°C temperature change from pre-industrial levels is a threshold which when crossed, the population affected by adverse impacts will increase exponentially. Limiting the temperature within this range with 50% probability will require stabilization of greenhouse gases at concentrations of around 450 parts per million (ppm) CO₂ equivalent. The likely stabilization target of 550ppm in the current scenario would raise the probability of breaching the threshold to 80% which is unduly risky, as it may lead to a temperature rise of 2.9°C.

Purpose of Research

Addressing climate change requires finances and technology to offset its basically inequitable impacts. The inequitable nature of the problem arises from the fact that while the developed countries are responsible for most of the historical and majority of the current emissions causing global warming, the adverse impacts will be more on the developing countries. Moreover, the developing countries grappling with the issues of human development and poverty needs energy for addressing these challenges which would require them to occupy at least a part of their entitled carbon space. This brings the challenge of development vs. sustainability to most of the developing world. The threat of extinction faced by some of the island nations and poor adaptation capacity of others exacerbate this predicament.

It is unethical and unreasonable to require the developing countries to locate resources for greenhouse gas(GHG) abatement (which, in the first place, is not their making) while struggling to fight poverty at their doorsteps. Therefore, it is imperative that while emission reduction actions should take place in developing countries where low-cost mitigation is possible, the resources for the same are provided by the developed countries. Another aspect of the issue is the transfer of climate-related abatement technologies, especially those of energy efficiency and renewable energy, to the needy nations to accelerate their progress along low carbon development pathways. It is obvious that both these imperatives would require a paradigm shift in the framework of international cooperation. A global crisis of the magnitude of climate change would require new and innovative approaches to its solution.

In order to take forward the cause of emission mitigation financing, it is necessary to have some equitable methodology to demarcate the contours of the apportionment of emission reduction responsibilities. These commitments are meant to be implemented in a global framework of marketable emission reduction instruments, which would facilitate the transfer of required resources to the countries where abatement and adaptation actions are needed. It has been found that agreement on a suitable framework has been eluding the elaborate multi-country negotiations held under the auspices of United Nations Framework Convention on Climate Change (UNFCCC) so far, though the Kyoto protocol was a sign-post in the right direction. But subsequent negotiation meetings including the latest Copenhagen conference

turned out to be disappointing with the developed and developing country blocks not able to find common ground for the convergence of emission reductions.

This communication attempts to survey the international efforts for emission apportionment so far and provide an equitable, actionable and verifiable framework for such apportionment.

Approaches towards Equity

The fundamental approach towards emission reduction was incorporated in the UNFCCC framework in 1992 and subsequently in the Kyoto Protocol, which may be called the 'Common but differentiated responsibility' (CBDR) principle. This foundational idea combined with the convergence approach arrived at during various negotiations, form the basis of an equitable approach to the issue. Translating these ideas into concrete, actionable and binding targets has been the concern of many a negotiation. The consensus on emission reduction targets have proved extremely difficult and time consuming. Though the architecture of the Copenhagen Accord is more flexible, it might prove ineffective in protecting the climate good from the tragedy of the commons. This will necessitate the search for consensus principles which are enforceable, as the risks start weighing down on the countries. The present analysis generates a model for equitable emission reduction apportionment.

There are a number of studies in the literature looking for a solution to this vexed issue. The most noteworthy contributions are:

(i) *Contraction and convergence Approach*: This has been advocated by the Global Commons Institute, which argues for an agreement on a target atmospheric concentration of GHGs at a future year, say 450 ppm in the year 2050 to arrive at per capita entitlements. These entitlements can then translate to possible emission reduction pathways for various countries.

(ii) *The Princeton Proposal*: Another interesting approach to the apportionment philosophy is the Princeton proposal formulated by a group of researchers at the Princeton University. Essentially the idea is the 'polluter pays principle' implemented on a global platform. The method statistically identifies about 1 billion global emitters who have to bear the burden of greenhouse gas mitigation, irrespective of their nationality. However, the emission targets based on their actions fall on the respective countries.

Dual Principle Approach

In contrast to these approaches, what is sought to be developed in this communication is a dual principle approach, which is based on the two most important universally accepted criteria for burden sharing, namely, 'the polluter pays principle' and the 'mitigation capacity principle'. These two criteria are interlinked in the sense that a country which is high on emissions will generally have a high GDP and corresponding mitigation capacity through the interrelationships relating to emission intensity. This approach is a logical extension of the notion of social equity between generations to that of equity within generation and is in consonance with the principle of common but differentiated responsibility.

Modeling of the Approach

The approach has been modeled on the basis of these dual principles leading to computations which would modify the responsibilities on a real time basis, as action plans unfold in various regions. The mathematical model of the dual principle approach has been designed utilizing mitigation capacity (based on GDP) and cumulative excess emissions (difference between actual or projected emissions and entitled emissions) as the criteria for apportionment. To arrive at the entitlement, the convergence target at a future year has been utilized which in turn depends on scientific computations regarding safe levels of containment of the global warming problem. Quantitative results have been arrived at, using cumulative gamma probability density function (pdf) and parabolic emission mitigation trajectories to demonstrate the impact on stakeholders. It is seen that the apportionment results are independent of the trajectory chosen, due to the iterative optimization of the trajectories to arrive at non-negative values for the mitigation coefficients.

Findings

Since the apportionment takes into account entitlements and the mitigation capacity, Africa and India have negligible reduction targets in tune with the development goals in these economies. Substantial reduction commitments would fall on the USA and the EU countries. China gets a moderate target due to higher emissions and GDP. The approach is in consonance with the principle of common but differentiated responsibility enunciated in the UNFCCC and the Kyoto Protocol. The method can easily incorporate emissions trading.

A major advantage of the method is that it can easily be adapted to take into account the emissions trading regime also, as these can be factored into the responsibility functions which are derived from cumulative excess emissions and GDP projections.

Comparison of 2030 scenario result shows that the share of OECD increases under the dual principle approach compared to the Princeton proposal. While India's share is almost identical in both regimes, China and Africa gets a higher commitment under the Princeton proposal. The share of USA remains comparable under both evaluations.

The Princeton proposal basically considers only income distribution of various countries and doesn't take into account the emission intensity of GDP or the historical emissions. The dual principle approach takes into account the dynamic nature of emissions and GDP profile along the trajectory and also emission entitlements based on a convergence approach. These aspects result in the share of the non-OECD lower in the dual principle approach. The apportionment arrived at in the dual principle approach appears to be relatively more stable and well-distributed since the computations are based on two separate variables representing two logical principles, for which independent data are available.

Methodologically, the procedure requires consensus on baseline emission scenarios as well as GDP projections for the mitigation period. However, since the computations would be on a continuous and real time basis, any actual variations from the baseline projections as well as variations in mitigation achievement levels

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can be factored into the calculations by modifying mitigation responsibilities accordingly in future.

Even extremely complex climate models give highly uncertain results as the projections extend far into the future. Therefore, though the present framework has been configured to indicate trends up to 2100, the projections beyond 2060 are likely to be subject to the limitations of unpredictability and uncertainty, particularly on account of the simple, empirical, and zero dimensional models used to simulate its climate inter-phase.

Roadmap towards Stabilization

As regards achievement options for emissions reduction, several activities relating to energy efficiency, water efficiency, urban design, mass transport etc can be identified each of which alone or in combination results in emission reduction. Though India has a very high potential to reduce the emission intensity of its GDP, it requires substantial investments. It is required to put in place a Climate Change Mitigation Facility as suggested in the Human Development Report (2007/2008) which would address the issues of mobilization of finance, mitigation of risks, building technological capabilities, buying out intellectual property and expanding access to energy.

Value

The present framework could be a useful choice in a situation of similar competing frameworks, which need to be assessed on the basis of appropriate criteria such as acceptability of the principles, simplicity, ease of implementation, ease of securing consensus on data, ease of duplication and comprehension, practicality of the

approach etc. The generalized framework can also be extended to situations involving mitigation responsibility apportionment of externalities in public policies.

Key Words

Equitable emission reduction apportionment, climate change, equity and fairness, mitigation capacity, parabolic mitigation, cumulative gamma pdf, UNFCCC, Kyoto Protocol, externalities, Global Warming