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Nupur Priya
Masters in Politics and International Studies, Department of Politics and International Studies, Pondicherry University, Pondicherry, India

Barbie Basumatary
Masters in Politics and International Studies, Department of Politics and International Studies, Pondicherry University, Pondicherry, India

Corresponding Author:
Nupur Priya
Masters in Politics and International Studies, Department of Politics and International Studies, Pondicherry University, Pondicherry, India

Carbon trading mechanisms in global and national contexts: A pathway to climate mitigation

Nupur Priya and Barbie Basumatary

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Abstract
The economic development of countries worldwide is facing a threat from rapid climate change. This has compelled nations to explore ways to mitigate climate change. Human activities like large-scale greenhouse gas emissions contribute heavily to global warming and climate change. One of the most prominent among these greenhouse gases is carbon dioxide (CO2). A potential solution to reduce carbon dioxide emissions while ensuring continued economic growth is the Carbon Trading Mechanism. This mechanism is a market-based policy tool used to reduce carbon emissions by allowing the trading of carbon emission rights between countries and within countries. It incentivises enterprises economically to reduce or avoid their carbon emissions through carbon credits. This mechanism is now used by countries to realise their pledges under the Paris Agreement, which constructed a legal base for creating a global carbon market. The scheme is already operational in many countries, both at national and regional levels. This paper strives to analyse the Carbon Trading Mechanism as a potential solution for climate change mitigation. The paper starts with an introduction to the topic, then attempts to create a brief understanding of the carbon trading mechanism; then, in the next part, it endeavours into the evolution of the idea of Carbon Trading, and thereafter, the next part is about the purpose and need of the mechanism. The paper then explores the contestations concerning the carbon trading mechanism's effectiveness in reducing emissions; then comes to evaluation of Glasgow CoP26 and the future of the carbon trading mechanism; then subsequently studies India's initiatives towards carbon trading, and then finally gives a conclusion. This paper is based on a mixed-method approach using both qualitative and quantitative research methods. It is based on secondary sources collected from scholarly articles, books, reports, newspaper articles, etc.

Keywords: Carbon trading, carbon market, climate change mitigation

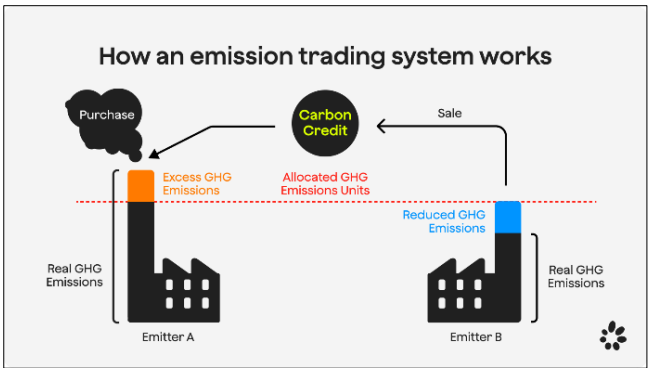
Introduction
An individual's good quality of life, growth and development depends on their environment. However, the notion of development adopted by nations worldwide is causing severe harm to the environment itself. It is not long since the nations have started worrying about the grave threat of climate change and global warming. This issue was first recognised during the second half of the twentieth century. The average global temperature reached 14.76 degrees Celsius in 2022, which is 1.06 degrees Celsius higher than that of before the Industrial Revolution. The fifth assessment report of the IPCC in November 2014 warned that there would be irreparable damage to the Earth's ecological environment caused by climate change. There is ample evidence of climate change and global warming in recent times, like melting glaciers, rising sea levels, warming oceans, floods and so on. The change in the statistical distribution of weather patterns and the lasting of such change over an extended period of time, like decades to millions of years, is called Climate Change. Although reasons for Climate Change can be categorised into human-induced causes and natural causes, however, natural causes like solar radiation or volcanic activity only account for less than plus or minus 0.1 degree Celsius to total warming between 1890 and 2010. Nevertheless, not surprisingly, human-induced global warming is increasing at a rate of 0.2 degrees Celsius. The greenhouse effect is the major factor responsible for climate change. In the greenhouse effect, the greenhouse gases trap the sun's heat in the earth's atmosphere and cause global warming. While many of these greenhouse gases are naturally occurring, the concentration of some of these gases are increasing rapidly due to human activities. These greenhouse gases include carbon dioxide, methane, nitrous oxide and fluorinated gases.

The largest contributor to global warming among these gases is carbon dioxide (CO2). Compared to before 1750, that is the pre-industrial era, the concentration of CO2 in the atmosphere has risen to almost 50%.

Therefore, it is imperative for the survival of humanity to reduce carbon emissions. Reducing emissions requires combined effort and cooperation of nations, as well as individual effort. This requires a change in the inherent ideals like capitalism at the individual level, national level and global level as well. The ideals of capitalism have led to this drastic change in the climate and environment. The majority of the efforts to mitigate climate change are either failing or are not that effective. The race started by the development parameters created by capitalism has led to exacerbated production of greenhouse gases. This addiction to fossil fuels is further worsening the situation. However, Newell and Paterson (2010), in their *Climate Capitalism*, argue that, in response to the rising concerns about climate change, a new kind of reorganisation of capitalism is taking place with a change in the values of the idea itself. This new paradigm is called 'Climate Capitalism', which is an attempt to decarbonise the global economy while simultaneously ensuring continued economic growth. This transformation in Capitalism has highlighted the Carbon Trading Mechanism as a potential solution.

So, this paper explores the history and potential future of the carbon trading mechanism. The paper also strives to analyse the understanding, purpose, need, evolution, and contestations regarding the mechanism. An appraisal of India's initiatives towards this mechanism along with Glasgow COP 26 is also discussed in the paper.

Understanding carbon trading mechanism



Source: Senken (2024)

Carbon Trading Mechanism is a market-based system in which carbon dioxide and other greenhouse gases are traded with the goal of limiting emissions. This mechanism rests on cap and trade regulations, which aim at market-based incentives to reduce pollution as an alternative to traditional measures. It works by creating a market with limited emissions allowances that decide on the price of emissions. This system incentivises nations, companies or any other entity to emit less greenhouse gases. It basically incorporates the price of emissions in goods and services. This mechanism is used by countries like China and the European Union to try to meet the pledges under the Paris Agreement.

Carbon markets enable entities like nations, companies or individuals to sell or buy carbon credits. These entities use these markets to compensate for their increased emissions by purchasing carbon credits from entities that have reduced their emissions. One carbon credit equals one tonne of reduced carbon dioxide. There are broadly two types of Carbon markets, namely, regulatory compliance markets and voluntary markets. Compliance markets are used by governments and companies to trade emissions and meet their targets, while voluntary markets rest on good intentions to reduce emissions on a voluntary basis.

Evolution of the idea

The 1980s and 1990s witnessed the rising concern over climate change and awareness to reduce greenhouse gas emissions. The first World Climate Conference in 1979 was an important event, as it laid the ground to discuss the implications of climate change on the international level for the first time (UNFCCC, 2000) [13]. In 1987, the Montreal Protocol was signed, which motivated countries to limit their emissions (DCCEEW, 2024) [2]. Countries like the US, Europe, Canada, New Zealand, and Singapore came up with carbon markets in tradable permits, enabling countries to buy and sell carbon and production quotas for CFCs and other ozone-depleting substances. "The 1990 Clean Air Act Amendment" in the USA can be considered as one of the early initiatives introduced to address the problem of climate change. The act addressed three major threats to the nation's environment: Acid rain, Urban air pollution, and toxic air emissions. The act also encourages market-based policies, emissions banking, and trading to achieve air quality goals (EPA, 2023) [3]. The United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the 1992 Earth Summit in Rio de Janeiro, a global commitment to protect the climate and address environmental issues. The convention was signed by 166 countries now (198), acknowledging the importance of the need to limit greenhouse gas emissions in the atmosphere. Although the agreement legally did not set binding emissions targets, it established the framework for international climate negotiations, acknowledging the need for collective action towards climate change. The Kyoto Protocol was signed in 1997 and came into force in 2005. It is one of the most effective initiatives taken to tackle the problem of climate change by limiting carbon emissions. The protocol introduced Carbon as a tradable commodity, including mechanisms such as carbon credit and carbon trading systems, which allow industries and countries to limit or offset their carbon emission through various initiatives, including renewable energy sources. Its target was to reduce GHG emissions by an average of 5% by 2012, while this provision was only for developed countries, excluding developing countries (Tardi, 2024) [12]. However, it faced challenges as the US did not sign the treaty, and other countries failed to meet their own targets. In the year 2005, the Kyoto Protocol came into force, and in the same year, the European Union Emission Trading System was also launched, which is, to date, one of the largest carbon markets globally (Taeuber & Smith, n.d.) [11]. The EU-ETS is focused on limiting and bringing down the emissions of overall countries under the European Union, and the revenue generated from it to be used for the finance of green energy and renewable technologies. It works on the basis of the "Cap and trade system," which refers to a defined limit set on the total amount of GHG emission. The Cap works through a system of emission allowances; one industry emits as per allowances given permitting the release of one tonne

of CO2eq, and these allowances can be sold and traded by other industries, and in the case where one industry has reached its maximum capacity of emission allowances, the industry can trade or buy carbon from another industry who has not reached its maximum capacity of emissions allowance or keep them for future use. By 2030, EU-ETS aims to reduce net emissions by at least 55% compared to the 1990s level (EU, n.d.). The Paris Agreement, signed in 2015, is a legally binding International Treaty on Climate Change. It was adopted at the UNFCCC's 21st conference by 196 parties at the UN Climate Change Conference (COP21) in 2015. Its aim is to "limit global temperatures to well below 2°C above pre-industrial levels and would pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (Maslin *et al*., 2023) [6]. Unlike the Kyoto Protocol, the Paris Agreement includes provisions and global commitments from both developing and developed nations and universal participation to tackle global warming and focuses on how collective action is required to achieve sustainable development and a clean environment. The agreement has not legally set fixed targets for countries, and each country can set its own reduction targets (Nationally Determined Contributions). The agreement envisages that developed countries should take the lead to guide developing countries, providing them with technologies and financial help to bring down emissions. In 2018, the California Carbon Market was launched, one of the largest carbon markets in the United States, linked with both the EU emission trading system and Canada Quebec's cap-trade system, which makes it one of the largest multi-sectoral emissions trading systems. It covers the sector including Transport, Building, Industry and Power. Its aim is to cut GHG emissions while completing other tasks that enable the state to meet its climate targets. On the same line, China launched its National Emissions Trading Scheme (ETS) in 2017, the world's largest carbon market in terms of emissions covered, and became operational in 2021 (Heggelund *et al*., 2022) [5]. Carbon Trading Mechanisms are being launched at the national and regional levels, making it a potential solution to various climate-related issues.

The need for carbon trading

Carbon Trading Mechanism is based on the idea which establishes property rights for the atmosphere. Whosoever burns fossil fuels and emits carbon in the atmosphere does not pay the price of the consequences. They only pay the fuel price, but there are other prices that are not covered, such as the implications of emitting carbon dioxide like global warming and air pollution. The atmosphere is a global public good as it is non-rivalrous and non-excludable, and so the carbon dioxide emissions are an international external cost. Climate change has an economic burden. This burden is not carried by the emitters as they do not pay the price of fallouts of emissions like destruction of the environment for future generations.

The use of non-renewable resources is still rising in all major sectors, which is a severe threat against the warning of rise of global warming by 2 degrees Celsius. The climate action goals of nations across the world require concerted and sufficient investment. The Nationally Determined Contributions (NDCs) listed that the developing nations will require up to six trillion USD to finance nearly half of their climate action goals by 2030 (UNDP, 2022). The current situation is that all the countries are facing financial troubles regarding their targets for climate action. Nations are witnessing around three to six times lower financial levels needed by 2030 (IPCC, 2022). Carbon trading mechanism can be a possible solution for a major part of this problem because carbon markets are instrumental in channelising finances to fund climate action programmes. Many policies and plans made towards climate change mitigation are not properly implemented because of insufficient funds. This mechanism works by incentivising the entity economically when it reduces or avoids emissions. This is a cost-effective mitigation mechanism that also helps nations to realise the Paris Agreement goal.

Apart from being a cost-effective method for climate change mitigation, this mechanism incentivises companies economically to invest in clean technologies and energy. The collateral benefits also include sustainable development and creation of green jobs by accelerating investments into renewable energy, such as wind energy and solar energy. This scheme makes climate action a business imperative and reduces mitigation costs.

Carbon trading: A contested solution for climate change mitigation

The Carbon Trading mechanism works by buying and selling certificates that indicate a reduction of carbon emissions. This mechanism also helps the government by effectively monitoring the quantity of carbon emissions generated in a structured way. However, this scheme adopted in various regions worldwide has no central international authority to harmonise it with the defined carbon budgets. Also, the Financial Times criticised this cap-and-trade mechanism, saying that "Carbon Markets create a muddle and leave much room for unverifiable manipulation". Many scholars argue that direct regulation is the best way to mitigate climate change and carbon market-based incentives are ineffective. There is also the high risk of offsetting real reductions rather than true emission cuts. The market volatility of carbon markets also creates uncertainty for companies as to investing in long-term emission reduction strategies. Issues related to double-counting of carbon emissions and greenwashing are also complex obstacles concerning this mechanism. The central argument against carbon trading mechanism revolves around the factor that economic efficiency is also an important aspect of this mitigation scheme rather that a fully focused climate change mitigation mechanism. These issues must be addressed for the successful working of carbon trading mechanism and evident reduction in carbon emissions.

Nevertheless, the effectiveness of this mechanism can be speculated by the ambit of the carbon markets. The potential global value of carbon markets was estimated at $948.7 billion in 2023. The future expectations for these markets are also very promising as to reach $2.68 trillion by 2028 and $22 trillion by 2050. So, if the standardisation of taxation policies, accounting and documentation regarding the export of carbon credits will be done, then the real potential of this mechanism can be seen.

Glasgow cop26 and the future of carbon trading

The 26th UN climate change conference of the parties (CoP26) was held in Glasgow in 2021. It focused on speeding up the global actions framed against climate

change. The summit considered it very important for countries to strengthen their respective 2030 targets by COP27. Major goals set during this summit were to keep the rise in global temperatures below 1.5 Degrees Celsius and above pre-industrial levels. It got 140 countries to announce target dates for achieving net zero emissions. This can be seen as a crucial way forward as compared to the Paris Agreement, where the developing countries disagreed to bring down emissions but rather reduced just the "Emissions-intensity" of GDP. Along with other outcomes, a key outcome of the COP26 climate summit in Glasgow was the approval of article 6 mentioned in the Paris Agreement's rule book governing carbon markets (World Bank, 2022) [26]. Carbon trading refers to trade in greenhouse gas (GHG) emissions targets by countries or their companies in order to fulfill commitments under environmental treatise such as the UN Framework Convention on Climate Change (UNEP, n.d.) [25]. The objective of UNFCCC is the "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (LSE, 2022) [21]. To strengthen the developed country commitments under the convention, the parties to the UNFCCC adopted the Kyoto Protocol, by which they agreed to "Quantified Emissions Limitations or Reduction Commitments." These reduction commitments seek to reduce net greenhouse gas emissions below 1990 levels by 5.2% over the period 2008-12(Art 3 of the Kyoto Protocol). The Carbon trading mechanism serves two major goals: 1) Reducing carbon emissions in line with government or self-applied targets and 2) financial gain. One business (seller) may be actively reducing carbon emissions as part of their general business operations and trades units of offset carbon emissions to another business(buyer) (MONTEL, 2024) [22]. There are 2 main types of carbon trading systems currently: The Emissions Trading System (ETS) And Carbon Offset. In an emissions trading system (ETS), a regulator defines an upper limit (Cap) of greenhouse gas (GHG) emissions that may be emitted in clearly defined sectors of an economy. Emission permits or allowances are given out or sold to the entities that are included in the ETS (ICAP, n.d.) [18]. However, the carbon market is very complex because of the number of participants with different types of certifying bodies and different rules in the market. As the climate change concern is reaching its peak, carbon trading is coming up as a solution. Carbon Trade Mechanisms have witnessed exponential growth since its inception, with its roots in the Kyoto Protocol motivating countries to come up with their own carbon market (Dabkara & Sengupta, 2022) [16]. While the compliance markets, like EU ETS, continue to generate interest and investment, the overall market value of voluntary offsets in 2023 was around $2 billion, which is approximately the same as it was in 2021. But at the same time, it is also important to look at what the future holds for carbon trading. If investors can be lured back to the idea of carbon markets, then the scope of its expansion is very high. To achieve this, there is a need to work on some basic aspects of carbon markets, such as Stability, Demand & Supply, and Take-off. The whole market of carbon trading is based on the environmental integrity of the credits being issued, purchased, and traded. Authorities such as the UN need to come ahead and intervene to set proper guidance and bring in transparency. Without this, the voluntary market will sidetrack itself from focusing on "Decarbonisation" to just hoping for some market formalization and money-making business. Clarity with respect to rules and regulations, along with penalties for trading irregularities, is something that will bring more stability and integrity to the market and eventually attract investors. In 2023, there was an oversupply of around 50% of carbon credits as the prices collapsed and investors had to finally quit the market (Choudhury *et al*., 2024) [15]. Demand for high-quality, transparent carbon credits needs to be matched with the current supply. Most of the private firms and governments of different countries are looking forward to fastening their progression towards the Net zero milestone, for which most of them rely on carbon offsetting as the way to decarbonisation. Hence, it's necessary for the market to focus on servicing the demand for quality credits, which will, in turn, help generate investment and push regulators and lawmakers to improve transparency and overall standards across the markets. Once steps are taken to stabilising the market, generating integrity and trust in investors, and managing the demand and supply aspect, carbon offsetting has the potential to take off in a way that will make 2021 seem like a trickle before the flood. "The market value of voluntary offsets can go up to $50bn by 2030", which means growth of twenty-five times compared to the current size (Blaufelder *et al*., 2021) [14]. Though the predictions seem too optimistic, it's not impractical. The need of the hour is that the right products are available for everyone, from eco-friendly consumer brands to traders who are less interested in saving the world and are rather motivated by monetary gains. There is a requirement for a solid foundation of trust that investors can bank on, and better offset programmes can be built upon.

India's initiatives towards carbon trading

India is actively working to establish its own carbon market as its objective is to decarbonise the Indian economy by limiting greenhouse gas emissions (GHG) (PIB, 2023) [9]. India's goal of establishing a carbon market falls in line with its target of net-zero emissions by 2070 and achieving its National Determined Contributions (NDCs) under the Paris Agreement. India is the third largest carbon producer in the world after China and the US, producing 4.13 Gt CO2e per year (Statista, 2024) [10]. One of India's targets is to reduce the "emissions intensity of its GDP by 45 percent from 2005 levels by 2030" (Nachtigall *et al*., 2021) [7]. All these global and national commitments have led India to focus on reducing emissions and installing mechanisms such as a carbon credit trading scheme and putting cap and trade on emissions. Globally, Carbon trading has come up as an essential mechanism to achieve global climate stability, and it can be divided into two categories: Compliance mechanism and voluntary mechanism. Compliance mechanisms, such as Emissions Trading Systems (ETS), which are managed by the government, focus on putting cap-trade allowances to their targets. Voluntary mechanisms are managed through independent entities or non-governmental organisations where entities voluntarily participate and offset their emission by purchasing carbon credits (Archer, 2023) [1]. In the case of India, it operates on two market-based emission reductions: the Perform, Achieve, and Trade system (PAT) and the Renewable Energy Certificates (REC) system (Philip, 2024) [8]. The Carbon Credit Trading System (CCTS), introduced by India

in 2023 and expanded in 2024, allows other entities to participate by providing tradable certificates, Carbon Credit Certificates (CCCs), which are worth one tonne of carbon dioxide equivalent (tCO2e), and certificates are obtained and registered through CCTs, which allows these non-government entities to participate in the carbon market (Jennifer, 2024) [19]. India, to reduce carbon emissions and ensure its integrity in monitoring, has empowered the National Steering Committee for the Indian Carbon Market and Bureau of Efficiency for monitoring, reporting, and verification (Thakur, n.d.) [23]. India is actively working on establishing its own carbon market and for the same purpose the Lok Sabha passed the Energy Amendment Bill,2022 to empower the government to create its own carbon market and put prices on carbon emissions by which the revenue generated is used in promoting sustainable energy (The Hindu, 2022) [24]. However, India is implementing CDM projects; out of 892 CDM projects currently implemented in India, 84.32% comes under the energy sector, both in renewable and non-renewable sources, followed by projects on energy demand covering 7.4% of total CDM projects (Ekka *et al*., 2016) [17]. The idea behind carbon projects is basically reducing carbon concentration in the atmosphere by reducing carbon emissions, by avoiding emissions or by carbon offsets. In India, the 3 major sectors of carbon trading are agriculture, forestry, and bioenergy. The agriculture sector contributes around 14% of global emissions, amounting to 6.6 Gt CO2/year in terms of global anthropogenic GHG emissions. Practices such as the use of chemical fertilisers, land conversion, destruction of pasture, livestock farming, rice growing, and burning of organic matter, mainly slash and farm burn as such are some of the major causes of GHG emissions in India. To deal with these emissions, it is important to use different methods such as using nitrogen fertilisers, using more organic fertilisers, planting legumes, avoiding leaving soil bare, reducing tillage, reducing the burning of farm waste, allowing straw to decompose naturally, etc. Another crucial point to note here is that GHG emissions can be reduced to about 89% by sequestering carbon in agricultural soil. For instance, 90% of rural energy requirements and 40% of urban energy requirements are fulfilled by biomass (Kumar *et al*., 2023) [20]. A huge amount of carbon can be reduced through effective burning devices. The Ministry of New and Renewable Energy (MNRE), Government of India should support improved cooking stoves, which can help to save fuel wood and thus could reduce dependence on forests. Bioenergy technologies should be encouraged to develop under CDM projects so that they can trim down dependency on fossil fuels and reduce CO2 emissions. The Carbon credit earned by adopting these practices and technology should be monitored and registered under unified national certification agency. Along with that, the potential of CDM and REDD projects to provide sustainable development and livelihood generation needs to be assessed. Over the years, though carbon trading is limited, there have been significant signs of growth of carbon trading mechanisms in India.

Conclusion

The pressing issue of human-induced climate change and its severe impacts calls for a practical and potential solution. This crisis started after the Industrial Revolution and continues due to development standards introduced to the world by Capitalism. Now, Climate Capitalism is a new approach to tackle this crisis. This new paradigm aims to decarbonise the global economy while maintaining economic growth. A key tool for this transition is the Carbon Trading Mechanism. Carbon Trading Mechanism is a market-based system in which carbon dioxide and other greenhouse gases are traded with the goal of limiting emissions. This mechanism has two essential tools called carbon market and carbon credit. The Carbon Trading Mechanism can be extremely instrumental in mitigating the climate crisis if transparency and integrity are attached to it. This mechanism puts a price on pollution and incentivises climate change action. This mechanism is based on a cap-and-trade system, which originated in the Kyoto Protocol. Paris Agreement laid down the legal framework for carbon markets. Countries like the US, China and India, and regions like Europe have implemented their own carbon trading schemes.

This mechanism addresses the externalities of carbon dioxide emissions and establishes property rights to the atmosphere. Carbon Trading also helps in investment in clean energy and technologies. Nevertheless, this scheme has both benefits and challenges; and the potential can only be achieved by addressing the challenges associated. The key is to build integrity in carbon markets to avoid carbon accounting risks. In spite of the complexities regarding the mechanism's proper implementation and various contestations, the role of carbon markets in reducing carbon dioxide emissions in the present and in the future stands crucial.

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