

The Incompatibility of Game Theory and Kyoto Protocol

Ernesto O. Golosino^{1*}

¹ College of Business and Accountancy, Holy Name University, Tagbilaran City, Bohol, Philippines

*Corresponding Author: ernestgolosino@hnu.edu.ph

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Abstract: *This research aimed to determine the reasons why Kyoto Protocol failed. In order to gather the needed information, the researcher only utilized information coming from legitimate institutions like the UNFCCC, research about Kyoto Protocol published in the web of science and from the Institute of Scientific Information (ISI) journals like Elsevier, Thompson Reuters, SciVerse, Scimago and from commentaries of world leaders and environmentalists. In order to access these materials, the researcher utilized EBSCOHOST as the primary search engine, with the aid of google scholar as additional search platform. The research utilized descriptive method coupled with qualitative and quantitative approach. The results of the study indicated that uncooperative act known as prisoner's dilemma is the main reason why Kyoto Protocol failed. The presence of United Nations Framework Convention on Climate Change (UNFCCC) which is the main convenor of Kyoto Protocol proved to be useless. It has no police power and cannot even sanction erring members or parties to the agreement. Meeting the goals of Kyoto Protocol is hard to accomplish when the parties involved betray in the agreement like what happened to the two prisoners in the highly celebrated doctrine of known cooperation known as Prisoner's dilemma.*

Keywords: Microeconomics, Kyoto protocol, game theory, externality

1. Introduction

The issue on global warming is not a private matter. One cannot simply maintain a lukewarm attitude towards this problem and wait for others to act on it. Critical point to be considered is the fact that the adverse effect of global warming is not exclusive but inclusive. Those who worked hard to mitigate the catastrophic outcome of climate change cannot exclude free-riders from the benefits of the said undertaking. Individual effort reaps no fruit at all, hence the necessity for collective actions. In political milieu, climate change served as the magnetic force that binds world leaders to act in unison.

Since the issue of global warming transcends from a mere theory into a reality, Kyoto Protocol was initiated. The Kyoto Protocol was adopted on 11 December 1997. Owing to a complex ratification process, it entered into force on February 16, 2005. The said protocol operationalizes the United Nations Framework Convention on Climate Change (UNFCCC) with 197 countries ratifying the convention. The ratification served as the covenant for these nations to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets which is stated in Annex B of the Protocol.

However, the introduction of Kyoto Protocol to the political mainstream of those countries which ratify it breeds espionage and dirty tactics. The tenor of the Protocol accords unequal responsibilities and obligations. Highly developed nations (marked as Annex I) must carry

heavy workloads while developing nations (Non-Annex I) are not required to reduce their emissions of GHGs. This compels other parties (mostly Annex 1) not to cooperate and betrays from the agreement. Two prominent countries namely Australia and the United States of America backout from Kyoto Protocol. Their dedications in arresting the problem forced them to trade-off economic gains to environmental concerns. Their subscription to Kyoto Protocol put them at a greater disadvantage while the playing field tilts in favor of the developing nations. This is not a fair game and this situation is best explained through a highly celebrated doctrine in economics known as Game Theory.

2. Review of Related Literature

The best way to diagnose what went wrong with Kyoto Protocol (also known as Climate Change Policy) is to determine the nature of this agreement. Since the purpose of Kyoto Protocol is to arrest the growing problem about global warming, this policy concerns about “collective good” (George-Duckworth, 2011). In economic parlance, collective good is akin to a commodity, a commodity commonly owned by the public at large (Victor, 2001; Mankiw, 2016). When commodity is commonly own, it becomes a public good (Mankiw, 2016). The common problem when an effort is directed to conserving, preserving and taking care of a public good is free-rider problem (Frank, Bernanke, Antonovics, and Heffetz, 2019). There is always a problem when collective efforts are directed towards any public good because even those who do not exert efforts will plainly gain from the positive outcome of an undertaking (Frank, et al., 2019).

Another way to assess the lapses of Kyoto Protocol is to determine the tenor of this Climate Change Policy. In terms of categorizing the nations which participated in this global battle against Green House Gases (GHGs); the records from the United Nations Framework Convention on Climate Change (UNFCCC, 2018) indicated that Article 2 up to Article 9 of the said Protocol indicated the functions and obligations of Annex I nations.

Annex I Parties include the industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States (UNFCCC, 2018). Pouloupoulos and Vassilis (2016) dubbed this approach as “ the principle of common but differentiated responsibilities”. This leads many industrialized nations to delay the ratifications of Kyoto Protocol (Sathiendrakumar 2003; Aldy and Pizer 2009). It took eight years for industrialized nations to finally ratify Kyoto Protocol in 2005 (Finus, 2008). In the language of McKibbin and Wilcoxon (2002) the Kyoto Protocol is a “deeply flawed agreement that manages to be both economically inefficient and politically impractical.”

On the other hand, Article 11 of Kyoto Protocol outlined the obligations of Annex II Parties. “These nations consist of the OECD members of Annex I, but not the EIT Parties. They are required to provide financial resources to enable developing countries to undertake emissions reduction activities under the Convention and to help them adapt to adverse effects of climate change. In addition, they have to “take all practicable steps” to promote the development and transfer of environmentally friendly technologies to EIT Parties and developing countries. Funding provided by Annex II Parties is channeled mostly through the Convention’s financial mechanism” (UNFCCC, 2018).

Developing countries belong to non-Annex I. Under this classification, these nations have no obligations in terms of reducing their emissions of GHGs (Chander, Tulkens, Ypersele, Willems, 1999). They were called to the Protocol just to serve as observer and guest. (UNFCCC, 2018).

Companies which operate within the jurisdiction of nations belonging to Annex I and Annex II faced greater challenges. With the limitations on the emissions of carbon dioxide (CO₂), these companies which heavily relied on fossil fuel as their main input to production may either (1) pay expensive fines, (2) carry out carbon reduction through process improvement, (3) buy emission credits on the CO₂ market, or (4) carry out carbon reduction through technology transfers in clean development mechanism (CDM) or thru joint implementation (JI) mechanism.

These arrangements are anti-profit and cost extensive. The findings of Falkner, (2019) were quite instructive. Economies which conscientiously followed the agreements under Kyoto Protocol suffered well-timed industrial implosion. While it is true that their love for mother earth transcends beyond borders, such act adversely diminished their economic gains (Gardiner, 2011 cited by Falkner, 2019).

An earlier study also outlined the reasons why many nations refused to march towards environmental protection. As aptly put by Badrinarayana, D. (2014), no less than the World Trade Organization (WTO) barred emerging economies from ratifying Kyoto Protocol. This was anchored on the view that emerging economies may lost its competitive edge against their giant rivals should the former switch to an environmental-friendly production style. But this is not possible. Kyoto Protocol is not shifting the world's energy base to renewable power in lieu of fossil-fuel-fired power sources (Ferrey, 2010).

There was also a folklore on this regard. Movants for environmental protection believed that the supply of fossil fuel will soon deplete. This might be true but they forget to account (Helm, 2012) that coal will become an emerging substitute for petroleum products (Schiermeier, 2012).

The paper of Newell, R. G., W. A., & Raimi, D. (2013) offered another ingredients which add up to the skewed enforcement of Kyoto Protocol centers on emission trading. In this scheme, nations which opted not to reduce the emission of their green house gases may simply pay certain amount as "polluters fee".

Another defect of the Kyoto Protocol is the imposition of territorial jurisdiction as to the reduction of GHGs. As earlier discussed, heavier yoke is upon the shoulders of the highly industrialized nation. In the context of externality and negative spillover, the efforts of industrialized nations may turn in vain because particles in the air will not stay within the territorial jurisdiction of nations. It will spread around thru the movements of the air. In this regard, the pollutants emitted from the factories situated in less developed nations will simply traverse to other boundaries. Based on the records of Funk & Wagnalls New World Encyclopedia (2018); negative externality and spillover are the main reasons why the United States of America refused to ratify Kyoto Protocol.

The finding of Funk & Wagnalls New World Encyclopedia (2018) draw its inspiration from Tresch (2015). The said scholar pointed out that Kyoto Protocol was essentially doomed by the time it was ratified. There are two reasons to support this conjecture. First, it did not apply to the developing countries, particularly the large developing countries such as China and India.

The other is that the United States dropped out of the Protocol in 2001, and US emissions of CO₂ represented 32% of total CO₂ emissions.

Another structural flaw is found in Article 12 of Kyoto Protocol. The institution of Clean Development Mechanism (CDM) breeds two more lopsided remedies namely; International Emissions Trading, and Joint Implementation (Article 6 Kyoto Protocol).

The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO₂, which can be counted towards meeting Kyoto targets. Closer scrutiny of this arrangement proved that there is actually not a reduction of CO₂ but a simple offsetting of emissions (Frank, et. al 2018).

International Emissions Trading also accords reckless nations an opportunity to shy away from the mantra of Kyoto Protocol. Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare - emissions permitted them but not "used" – to sell this excess capacity to countries that are over their targets (UNFCCC, 2018). According to Tian, Wu, Zhao, Ma and Zhang (2019), when Kyoto Protocol came into force, the global [carbon trading](#) market exploded. From 2006 to 2007, the global carbon trading volume jumped from 1.6 to 2.7 billion tons, an increase of 68.75%. The market value of global carbon trading rose from 22 to 40 billion euros, up 81.8%. In 2012, the global carbon trading market reached \$150 billion, surpassing oil trading as the world's largest market.

The mechanism known as "joint implementation", defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO₂, which can be counted towards meeting its Kyoto target (UNFCCC, 2018). This scheme will not promote abatement of CO₂ but simple sharing of cap or limits to the assigned targets (Seo, 2017). The researcher's contention was based on the findings advanced by Nordhaus in 2008 which mentioned that "a fatal flaw of the Kyoto Protocol as a global policy to address the problem of global warming turned out to be a low rate of participation".

Many scholars believed that when the issue calls for a collective effort and when it is to be participated with stakeholders coming from all corners of the universe, there is a great possibility for lukewarm commitment (Callaghan and Kumazawa, 2010). These authors insisted that the effectiveness of the international agreement has been long debated since its inception in 1997. This is according to the contentions of Rollings-Magnusson and Magnusson 2000; McKibbin and Wilcoxon 2002; Bohringer, Vogt 2004; Helm 2003; Sathindrakumar 2003; Barrett 2008; Winkler, Almer 2017). The intention of fully reducing the emissions of GHGs will not work when parties involved in this treaty are allowed to trade their excess capacity thru carbon trading (Dasgupta, Laplante, Wang, and Wheeler 2002; Jaffe, Peterson, Portney, Stavins 1995; Sathindrakumar 2003).

Another condition which hinders the full blast enforcement of Kyoto Protocol is the tenor of the agreement enshrined in the World Trade Organization (WTO). The investigation of Badrinarayana (2014) uncovers the reason why most developed nations (some of them already ratified Kyoto Protocol and later retracted from their commitment while others like USA did not ratify) changed heart about the said agreement. As discovered by Badrinarayana (2014),

Annex I signatories of the Kyoto Protocol are left with no choice but to still accept imports from nations with high carbon footprints. Blockade on the entry of these products into the economies of Annex I signatories tantamount to unilateral trade barrier, which is forbidden under the agreements espoused in WTO. This situation compelled the United States of America, Canada, Japan, and Russia to finally reject their obligations. The said author also pointed out that this situation further pushed the capitalists from Annex I signatories to be playing in a game where the roles always favor the capitalists from non-signatories of Kyoto Protocol. This is exactly the reason why China (the notorious emitters of GHGs) refused to be bounded by the mandate of Kyoto Protocol.

Anent to the earlier discussion, “an effective treaty framework to reduce emissions require a legal solution to this economic puzzle” says Harvey and Stern (2012) as cited by Badrinarayana (2014). However, the present framework of Kyoto Protocol failed to install mechanisms for reward and penalty. According to Grant and Keohane, 2005; there must be an improvement on accountability to limit abuses of power in world politics.

This unfolds the reason why Canada; the first to ever follow the mantra of Kyoto Protocol ended up losing so much money in the global arena, Bohringer and Rutherford (2010). When the said nation ratified the agreement, it installed specific mechanisms on how to reduce carbon footprints in all aspects of production and consumption. Being a member of WTO, it cannot refuse the entry of goods produced by countries with high carbon footprints. In general, this condition puts Canada at the sideline of competition. Products produced from this country ends up too expensive as compared to the products made by its rivals. This further created ironic conditions; in the local markets of Canada, Canadians prefer to buy imported goods since the prices were much lower than the locally produced goods. In the global market, Canadian products cannot compete with their rivals due to price disparity.

Mclean and Stone (2012) dubbed the above-cited condition as the politics of Kyoto Protocol. The observations of Meunier and Jacoby in 2010 cited by Mclean and Stone (2012) mentioned that “European countries strategically subordinate their domestic politics to international cooperation in order to position the European Union as a key agenda setter in international institutions”. However, this move comes with a prize. The cost of compliance accrues not to the European nations but to the traders within these nations. Their productive processes become so costly in the name of environmental protection. This is their greatest economic trade-off without even seeing that the culprits get punished.

Accountability is very hard to established since the framework of the climate change policy accords no specific penalty for any erring member of the convention. Instead, the decision to punish or not, to expel from the convention or not, is delegated to UNFCCC. This breeds problem according to Grant and Keohane (2005) citing Scott (2000).

On its entirety, the findings of many scholars boil down to one thing that is; Kyoto Protocol failed to meet its goals. This is attributed to the following factors; the nature of the agreement and the tenor of the agreement. In order to put this into perspective, a model must be installed to magnify the reasons why uncooperative behavior prevails over altruism (Frank, et al., 2019). Uncooperative behavior is one of the anchors of Game Theory (Gardiner, 2006 cited by Sterescu, 2018). Per evaluation of Sterescu (2018) citing the work of Wood in 2011; it was found out that uncooperative acts lead to social dilemma. As aptly put by these authors, “ a social dilemma is a situation in which a non-cooperative outcome is sub-optimal”.

In the context of Kyoto Protocol, this means that the efforts of Annex I nations yield no definitive outcome because it is to be eaten up by the free-riding effects of non-Annex I nations. This situation leads to a deadlock, which in the end geared towards worst outcome. In the terminology of Frank, et al., 2019, this is known as “The Prisoners Dilemma”.

Prisoner’s dilemma was simplified by Beggs (2018). “In the game itself, rewards are to be represented by cardinal numbers which means that 1 is lower than 2; 2 is lower than 3 and so on. Since the players will be entangled with 4 strategies, cardinal numbers from 1 to 4 best represent the payoff for the players”. When one of the players outsmarts the other, the former gets the highest reward which is 4 while the latter receives the lowest payoff of 1 (Sterescu, 2018). Cardinal numbers 2 and 3 are not the optimal rewards (Frank, et al., 2019).

Table 1: Prisoner’s Dilemma Involving Environmental Policy

		COUNTRY A	
		Reduce Emissions	Do not reduce Emissions
COUNTRY B	Reduce Emissions	3,3	1,4
	Do not reduce Emissions	4, 1	2,2

In the name of environmental protection, the tall order was to reduce emissions of GHGs (van der Gaast, 2017). If Annex I and Annex II nations will religiously comply, they will only get a reward of 3 because compliance comes with a price. They need to overhaul conventional production processes and embrace sustainable means of production.

But the pay-off matrix shows that there is always an incentive to cheat or betray from the agreement. Those who opt not to reduce emissions end up getting 4 as their hypothetical reward while according only 1 for those who religiously comply with the agreement. This situation leads for any party to act strategically.

According to Hsu (2012) the best action to take is not to reduce emissions. This is the winner take all condition. Hence, all parties will move towards this direction in the hope that the adversarial party will take the other strategy. If all of them dwell here, they end up getting lower rewards (hypothetical value of two). This is what is known as prisoner’s dilemma (Frank, et al., 2019) where non-cooperative act leads to worst outcome (Finus, 2000).

Statement of the Problem

This study aims to determine the reasons why Kyoto Protocol failed. The following are the objectives of this paper;

- 1) Who should enforce Kyoto Protocol?
- 2) What are the incentives and disincentives in complying and defying Kyoto Agenda?
- 3) World leaders are fully aware that the effects of global warming cover all species on Earth, but what push them to remain lukewarm about this reality?

3. Methodology

To achieve the purpose of this study, the researcher made use of a descriptive method of research with the interface of qualitative and quantitative approach.

Further, the researcher utilized desk research as the main tool for data gathering. Johnston (2014) citing the paper of Creswell in 2009 elucidated that desk research utilizes secondary data analysis in a systematic method; with procedural and evaluative steps but argued that there is no specific literature which defines the specific process of the said approach.

The researcher embarked on the following steps. First; made an extensive analysis of the tenor, metes and bounds of Kyoto Protocol using cross-context approach. Second; determine the loophole(s) of this global initiative based on the assertions advanced by many scholars. Third, use the concepts of game theory as specific means of determining the reasons for the prevalence of the “uncooperative acts” among world leaders. Fourth, draw conclusions and offer arguments that the problem could have been solved using “Nash equilibrium”.

4. Results and Discussions

The main problem which derailed the enforcement of Kyoto Protocol orbits around the tenor and nature of this environmental policy.

The tenor and nature of Kyoto Protocol unfold the following problems;

- 1) The Game of “Wait and See”
- 2) The subdivision of members/the clustering and labelling of members
 - a. Obligations of Annex I, Annex II Parties
 - b. The role of non-Annex I Parties
- 3) Negative externality which proceeds from free-rider problem (Pollutants do not stay static in the air)
- 4) Clean Development Mechanism
- 5) International Emissions Trading
- 6) Joint Implementation
- 7) From fossil fuel to renewable energy

In using game theory particularly the prisoner’s dilemma as the main tool in quantifying the reasons why the said policy failed, hypothetical values are indicated. This numerical values served as indexed in determining who gains and who reap losses. This is much easier than indicating qualitative index in the pay-off matrix.

For uniformity, the researcher used 1,2,3, and 4 as permanent numbers indicated in the pay-off matrix of a prisoner’s dilemma.

Table 2: The Game of “Wait and See”

		COUNTRY A	
		Ratify	Do not ratify
COUNTRY B	Ratify	3,3	1,4
	Do not ratify	4, 1	2,2

According to the records of UNFCCC, 2018, Kyoto Protocol was introduced on December 11, 1997 but only enter into force on February 16, 2005 with the United States taking the centerstage as the prime mover of this policy but only to exit from the agreement in later years.

This renders UNFCCC as mere stamp pad and devoid of any blanket authority. Thorough review of the articles of Kyoto Protocol proved that this climate change policy simply clings on mere commitment. Even if UNFCCC is authorized by the United Nations as the main convenor of this environmental program, it has no police power to sanction erring members. There was no specific explanation why it took eight years for many nations to ratify this policy but game theory thru prisoner’s dilemma could offer a plausible explanation. It can be inferred from the table that if both nations (A and B) will ratify Kyoto Protocol, the overall gain will be 3. Both nations will share this gain, but this is not in monetary form but only the prestige of being the forerunner of environmental conservation.

On the other hand, if one nation ratifies while the other opt not to ratify, greater gains accrue to those who stay adamant. This is because there is greater monetary cost involved in ratification. Once the nation commits to this environmental policy, the conventional way of production using fossil fuel must be overhauled and be replaced with environment-friendly methods. This further redounds to loosing the competitive edge of the industry situated in that country as compared to its rivals operating from countries which do not heed to the call of environmental protection (George-Duckworth,2011).

The dominant strategy under this set-up is not to ratify. If one commits to ratify and take the first move, the other party always possess the edge of not ratifying. As a consequence, it took longer time to convince the parties to ratify the agreement. This defeats the purpose of Kyoto Protocol which aimed to reduce GHGs. The lapsed of 8 years would mean more GHGs emitted to the atmosphere to the detriment of the ozone layer.

Table 3: The subdivision of Parties

ANNEX I, ANNEX II			
NON-ANNEX I		Reduce GHGs	Do not reduce GHGs
	Reduce GHGs	3,3	1,1
	Do not reduce GHGs	4, 1	4,1

The scenario presented in this table jived to the findings of Mankiw, 2016; Frank, et al., 2019) which highlighted the effects of free-rider for any public good or common resources.

Common responsibility was never established when Kyoto Protocol was created. Instead, greater disadvantage tilt towards advanced economies/highly developed nations. Per record of UNFCCC, 2018, advanced economies were labelled as Annex I. These nations carry greater commitment of reducing their emissions of GHGs (as indicated in the appendix of this research). Their targets known as Annex B carry a tall order and a point of no return. This means that these nations have no choice but to follow their targets no matter what.

On the other hand, Annex II parties still belong to advance economies/highly developed nations yet their economies were undergoing “economies in transit (EIT)” due to changed in political landscape and economic integrations. Annex II parties have the obligation of reducing their GHGs (target known as Annex B) and at the same time must provide funding and sharing of resources to Non-Annex I parties.

In the first place, the articles of Kyoto Protocol accord no obligations and responsibilities for non-Annex I parties to reduce their GHGs. They were just enlisted in the Protocol as guests

and observers but if efforts were drawn towards the reductions of their GHGs, they can solicit funding from Annex II parties.

This explains why all favors flow towards non-Annex I parties. On top of these observations, no single article of Kyoto Protocol outlines any reward or penalty. This is because the creation or subdivision of nations as Annex I, Annex II, and Non-Annex I is by itself a penalty for the rich nations and a reward for the developing nations.

Table 4: Free-rider and Negative Externality

		ANNEX I, ANNEX II	
		Reduce GHGs	Do not reduce GHGs
NON-ANNEX I	Reduce GHGs	3,3	1,1
	Do not reduce GHGs	4, 1	4,1

Wood, 2011 cited by Sterescu, 2018 advanced the argument that uncooperative act leads to social dilemma. In the context of environmental protection, those who worked hard for the conversation of the planet cannot solely reap the fruits of their labor. This is due to the non-exclusivity of the benefits which lead to free-rider problem (Mankiw, 2018).

Annex I and Annex II parties work hard and spent billions of dollars in order to reduce the emission of their GHGs. In 2012, records from UNFCCC, 2018 indicated that the commitment of these parties as enshrined in Annex B of the Protocol yield considerable reductions of GHGs. This is highly commendable but comes with a cost. The positive outcome of their labor accrues not only to them but even to those countries which exerted no efforts in changing their productive processes.

No one can build walls in order to prevent clean air from circulating around the earth. On the other hand, there is no device which will prevent pollutants from spreading around. This means that the efforts of Annex I and Annex II parties were simply eaten up by the uncaring attitude of Non-Annex I parties.

Table 5: Clean Development Mechanism (CDM)

		ANNEX I, ANNEX II	
		Implement emission reduction projects	Do not implement emission reduction projects
NON-ANNEX I	Implement emission reduction projects	4,1	4,1
	Do not implement emission reduction projects	4, 1	4,1

Article 12 of Kyoto Protocol “allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries dubbed as Non-Annex I” (UNFCCC, 2018).

This mandate put Annex I and Annex II parties in stalemate and install non-Annex I parties as prima donna. In the first quadrant, non-Annex I parties simply wait for any dole-out from their

rich counterpart. In the absence of any dole-out, Annex I parties have nothing to lose because there is no mandate for them to reduce their emissions of GHGs.

On the other hand, Annex I and Annex II parties are bounded by their commitment enshrined in Annex B of the Protocol. Their failure to subscribed to their promises install them to the throne of hypocrisy.

Table 6: International Emissions Trading (IET)

		COUNTRY A	
		Meet quota (reduced GHGs)	Failed to meet quota
COUNTRY B	Meet quota (reduced GHGs)	3,3	2,4
	Failed to meet quota	4, 2	4,4

Article 17 of Kyoto Protocol provides the mechanism where any member of Annex I or Annex II parties which happened to meet their quota in reducing their GHGs may trade their excess to those who failed to comply.

Newell, R. G., W. A., & Raimi, D. (2013) dubbed this new modality as “carbon market”. In simple mathematics, this means that if the total emission of GHGs must have a cap of only up to 50 units. Assuming further that there are only ten countries which manifested their commitment. In the end, it is very clear that each country must only emit up to their specific limit. But the carbon trading renders this equation useless. The success of one country in religiously reducing the emission of their GHGs gives them economic incentive to trade their excess. On the other hand, those who recklessly disregard their quota faced no problem at all because they can simply buy from those who experiences surpluses.

This is an exercise in futility. The pay-off matrix indicated that if both nations comply with their emission targets, they mutually gain from it. But if one missed the quota (this means that more GHGs were emitted because of conventional production processes-which is cheaper) the concerned party need not worry because of the existence of carbon market. Hence, the best strategy for any opportunist is to miss the quota.

Table 7: Joint Implementation

		COUNTRY A	
		Meet quota (reduced GHGs)	Failed to meet quota
COUNTRY B	Meet quota (reduced GHGs)	3,3	2,4
	Failed to meet quota	4, 2	4,4

According to UNFCCC “The mechanism known as joint implementation defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO₂, which can be counted towards meeting its Kyoto target”.

Joint implementation is the hybrid of carbon market. It can be recalled that in the carbon market any country from either Annex I or Annex II parties which experienced problem hitting their quota for GHGs will simply buy from those who have surpluses. Under joint implementation, highly developed nations may forge partnership in developing projects aimed at reducing the emissions of GHGs.

This arrangement appears to be noble but embeds an ugly consequence. This will push any country from Annex I or Annex II to become irresponsible and avoid reducing the emission of their GHGs. Once they failed to meet their target, they will not resort to carbon market because this is expensive but move towards joint implementation as cheaper scheme of reducing their GHGs.

Table 8: Fossil fuel or Renewable Energy?

		COUNTRY A	
		Fossil Fuel	Renewable Energy
COUNTRY B	Fossil fuel	4,4	4,2
	Renewable Energy	2,4	1,1

One of the best ways to reduce the emission of GHGs is to shift from the utilization of fossil fuel to renewable energy (Gardiner, 2011 cited by Falkner, 2019).

But with nations spying from each other (in the context of Kyoto Protocol), it is impossible to see one country moving towards renewable energy (Frank, et al., 2019). The pay-off matrix indicated that the dominant strategy is to settle for fossil fuel. This gives them high leverage because nothing is to be done, just keep the status quo. Traders from this country will greatly benefit from this move because their cost of production remains competitive than those who installed modern production processes.

5. Conclusions

Conserving mother earth is everyone’s business. But greater obligations hang on the shoulders of world leaders especially the superpowers.

The introduction of collective efforts in mitigating the irreversible effects of the destruction of ozone layer is a timely initiative. But the trajectory of this noble undertaking will be hindered by selfish motives. Collective efforts must be done without regard as to who benefits more and who gains less since the benefits cannot be contained in one location but accrues to all species on earth.

Kyoto protocol was a beautiful masterpiece only to be besmirched by the irreversible consequence of non-cooperation.

References

- Aldy, Joseph E.; Pizer, William A. (2009). Issues in Designing U.S Climate Change Policy. International Association for Energy Journal.
<https://tinyurl.com/2phbw37n>

Almer, Christian; Winkler, Ralph (2017). Analyzing the effectiveness of international environmental policies: The case of the Kyoto Protocol
[Journal of Environmental Economics and Management](#), Elsevier, vol. 82(C), pages 125-151.
DOI: 10.1016/j.jeem.2016.11.003
<https://tinyurl.com/33sndvtc>

Badrinarayana, Deepa (2014). TRADING UP KYOTO: A PROPOSAL TO AMEND THE PROTOCOL, PART I
HEINONLINE.
<https://tinyurl.com/2nuwsvhm>

Barrett, Scott (2008). Climate Treaties and the Imperative of Enforcement
Oxford Review of Economic Policy: Volume 24, Number 2, 2008, pp 239-258
<https://tinyurl.com/3jyj8z9x>

Beggs, Jodie (2018). The Prisoner's Dilemma. ThoughtCo.
<https://tinyurl.com/2zkrtbxx>

[Böhringer](#), Christoph; [Vogt](#), Carsten (2004). Economic and environmental impacts of the Kyoto Protocol
Canadian Journal of Economics
<https://tinyurl.com/4abvjdmr>

[Böhringer](#), Christoph and [Rutherford](#), Thomas (2010). The Costs of Compliance: A CGE Assessment of Canada's Policy Options under the Kyoto Protocol
[The World Economy](#), 2010, vol. 33, issue 2, 177-211
<https://doi.org/10.1111/j.1467-9701.2009.01229.x>
<https://tinyurl.com/56etbc2h>

[Chander](#), Parkash; [Tulkens](#), Henry; [Ypersele](#), Jean-Pascal Van; [Willems](#), Stephanie (1999). The Kyoto Protocol: An Economic and Game Theoretic Interpretation
Center for Operations Research and Econometrics Working Paper No. 9925, CESifo Working Paper Series No. 229
<https://tinyurl.com/2sb634hv>

Dasgupta, Susmita; Benoit Laplante, Hua Wang and David Wheeler (2002). Confronting the Environmental Kuznets Curve
Journal of Economic Perspectives—Volume 16, Number 1—Winter 2002—Pages 147–168
<https://tinyurl.com/7jnamx5p>

[Falkner](#), Robert (2019). The unavoidability of justice – and order – in international climate politics: From Kyoto to Paris and beyond
<https://doi.org/10.1177/1369148118819069>
<https://tinyurl.com/he2udy48>

Frank, Robert H.; Bernanke, Ben S.; Antonovics, Kate; Heffetz Ori. Principles of Microeconomics 7th Edition.
McGraw-Hill Education, 2 Penn Plaza, NY 10121. 2019

Ferrey, Steven (2010). The Failure of International Global Warming Regulation to Promote Needed Renewable Energy

Boston College Environmental Affairs Law Review

<https://tinyurl.com/4ufzs4bk>

Finus, Michael. (2008). Game Theoretic Research on the Design of International Environmental Agreements: Insights, Critical Remarks, and Future Challenges. International Review of Environmental and Resource Economics

DOI: 10.1561/101.00000011

<https://tinyurl.com/4njdc3hy>

Funk & Wagnall's New World Encyclopedia

<https://tinyurl.com/fshn8mdd>

George-Duckworth, Andriana M. (2011) The Collective Goods Problem in Managing Environmental Issues, *Peace Review*, 23:2, 214-220, DOI: [10.1080/10402659.2011.571614](https://doi.org/10.1080/10402659.2011.571614)

<https://tinyurl.com/9pfndcnc>

Grant, Ruth W.; Keohane, Robert O. (2005). Accountability and Abuses of Power in World Politics

Published online by Cambridge University Press: 04 April 2005

<https://tinyurl.com/2n3258kf>

Helm, Carsten (2003). International emissions trading with endogenous allowance choices

[*Journal of Public Economics*](#)

ScienceDirect/ELSEVIER

[Volume 87, Issue 12](#), December 2003, Pages 2737-2747

[https://doi.org/10.1016/S0047-2727\(02\)00138-X](https://doi.org/10.1016/S0047-2727(02)00138-X)

<https://tinyurl.com/ys467fd8>

Helm, Dieter (2012). The Kyoto Approach Has Failed. *Nature Briefing Newsletter*

Nature 491, 663–665 (2012)

DOI: <https://doi.org/10.1038/491663a>

<https://www.nature.com/articles/491663a#citeas>

Jaffe, Adam B. ; Peterson, Steven R. Portney, Paul R. and Stavins Robert N. (1995) .

Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?

Journal of Economic Literature

[Vol. 33, No. 1 \(Mar., 1995\)](#), pp. 132-163 (32 pages)

Published By: American Economic Association

<https://www.jstor.org/stable/2728912>

Kumazawa, Risa & Callaghan, Michael (2012). "[The effect of the Kyoto Protocol on carbon dioxide emissions](#),"

[*Journal of Economics and Finance*](#), Springer;Academy of Economics and Finance, vol. 36(1), pages 201-210, January.

DOI: 10.1007/s12197-010-9164-5

<https://tinyurl.com/4a8vfxdn>

- Mankiw, N. Gregory (2006). Principles of Microeconomics 5th Edition. Harvard University. South-Western Cengage Learning
<https://www.udg.edu.me/download/122/preuzimanje>
- McKibbin, Warwick, J., Wilcoxon, and Peter J. (2002). "The Role of Economics in Climate Change Policy."
Journal of Economic Perspectives, 16 (2): 107-129.
DOI: 10.1257/0895330027283
<https://tinyurl.com/yrj3ctpr>
- McLean, Elena V. and Stone, Randall W. (2012). Two-Level Bargaining and European Integration
International Studies Quarterly
Vol. 56, No. 1 (March 2012), pp. 99-113 (15 pages)
Published By: Wiley
<https://www.jstor.org/stable/41409825>
- Newell, Richard G.; Pizer, William A.; Raimi, Daniel (2013). Carbon Markets 15 Years after Kyoto: Lessons Learned, New Challenges.
Journal of Economic Perspectives
Vol. 27, No. 1, Winter 2013 (pp. 123-146)
DOI: 10.1257/jep.27.1.123
<https://tinyurl.com/97hwxu2v>
- Nordhaus, William D. (2008). Economic Analyses of Kyoto Protocol: Is There Life After Kyoto
<https://tinyurl.com/4dey37we>
- Poulopoulos, Stavros; Inglezakis, Vassilis (2016). Basic Principles, Human Activities, and Environmental Implications. Elsevier 2021
<https://tinyurl.com/wn7d3v3e>
- Rollings-Magnusson, Sandra; Magnusson, Robert C. (2000). The Kyoto Protocol: Implications of a Flawed but Important Environmental Policy
[Canadian Public Policy](https://www.jstor.org/stable/2634883), University of Toronto Press, vol. 26(3), pages 347-359, September.
<https://tinyurl.com/atym2cmv>
- Sathiendrakumar, R. (2003). Greenhouse emission reduction and sustainable development.
International Journal of Social Economics 30(12):1233-1248
DOI: 10.1108/03068290310500643
<https://tinyurl.com/tzythyzz>
- Seo, S. Niggol (2017). Negotiating a Global Public Good
The Behavioral Economics of Climate Change, 2017
ScienceDirect
<https://tinyurl.com/3a7cfn7m>
- Schiermeier, Quirin (2012). The Kyoto Protocol: Hot Air
National Library of Medicine. National Center for Biotechnology Information
DOI: 10.1038/491656a

<https://pubmed.ncbi.nlm.nih.gov/23192127/>

[Sterescu](#), Andrei-Bogdan (2018). The Prisoner's Dilemma in Environmental Politics: One Model to Rule Them All?

<https://tinyurl.com/4udz8yc>

Tian, Wenjie ; Wu, Xudong ; Zhao, Xueli ; Ma, Rong; Zhang, Bo (2019)
Quantifying global CH₄ and N₂O footprints
Journal of Environmental Management, Volume 251, 1 December 2019, 109566
ScienceDirect

<https://doi.org/10.1016/j.jenvman.2019.109566>

<https://tinyurl.com/ya7rr2x9>

Tresch, Richard W. (2015). An Application of Externality Theory.
Public Finance, A Normative Theory
3rd Edition 2015
ScienceDirect

<https://www.sciencedirect.com/book/9780124158344/public-finance>

United Nations Framework Convention on Climate Change

<https://tinyurl.com/y5asd5u8>

Victor, David G. (2001). The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming. Princeton University Press

<https://www.jstor.org/stable/j.ctt7t8pq>