Available online at https://ijmras.com/

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND STUDIES
ISSN: 2640 7272
Volume: 04; **Issue**: 08/ 2021

GUIDE TO INDEX SUPPORTED HISTORICAL CUMULATIVE EMISSION PER CAPITA

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ARTICLE INFO

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ABSTRACT

This paper uses the Lorenz curve and Gini index with adjustment to per capita historical cumulative emission to construct the carbon Gini index to live inequality in global climate change areas. The analysis shows that 70% of carbon space within the atmosphere has been used for an unequal distribution, which is sort of identical to that of incomes during a country with the largest gap between the rich and therefore the poor within the world. Carbon equity should be an urgency and priority within the climate agenda.

KEYWORDS: climate change; carbon equity; long-term mitigation goal; cumulative emission per capita; carbon Gini index.

1. INTRODUCTION

One of the key problems with addressing global climate change is to enact an inexpensive global long-term emission reduction target and implement the equal allocation of CO2 emission space. The quantitative global long-term target will definitely limit the worldwide CO2 emission space. The unequal allocation of the limited CO2 emission space would largely restrict the longer-term emission space of developing counties. The earth's atmosphere could be a human's public resource, and reasonable emission space is indispensable for human development. Therefore, we should always allocate and use the emission space under the principle of world carbon equality.

This is often the cornerstone of world cooperation in addressing temperature change. Moreover, they proposed the rule that supported the principle of cumulative emission per capita convergence. Under this principle, Chinese scholars proposed the carbon budget and carbon emission account methods [Pan, 2008; PTDRCSCC, 2009] because of the emission space allocation system design.

Although cumulative emission per capita reveals the various historical responsibilities for various countries, it cannot provide a comprehensive index that covers every country's cumulative emission per capita, nor can it provide a general measurement of emission space allocation equality. Therefore, many studies used the income equality measurement method and measured emission equality with different income equality indexes. Helenus and Azar [2005] measured emission in- equality across countries by the well-known Atkinson index. Duro and Padilla [2006] applied the decomposable. The l index of inequality to emissions and showed convincingly that global inequality in per capita emissions was large because of inequalities in per capita in- encounter countries. Heil and Wodon [1997; 2000] used the Gini index to live the inequality of emission across countries. The contribution of this paper is to reestablish the carbon Lorenz curves and Gini indices supported the historical cumulative emission per capita which has an important difference with the annual per capita emission measurement. First, the lifetime of gas (GHG) within the atmosphere is over a century.

The cumulative emission can show a country's global climate change historical responsibility more clearly than annual emission. Second, emissions of GHG within a specific period of your time determine the temperature rise. The equality is to be a measurement of the general emission allocation during a certain period, instead of that of annual emission allocation.

2. CARBON EQUALITY AND MEASUREMENT

The essence of carbon equality is to live the allocation difference of emission space. Although allocation difference could be a new topic in global climate change studies, it's been thoroughly investigated within the income allocation equality researches [Wan, 2009; Xu, 2008].

The Gini coefficient is that the most generally used index. Such in- dices are usually wont to statically mapping the wealth allocation and social stability of a specific country or district. The Lorenz curve was initially proposed by Lorenz in 1907.

If the population shares aren't capable of the income shares, inequality exists. If the allocation is perfectly equal, then the Lorenz curve is that the line with a slope of 45◦. supported the Lorenz curve, Gini proposed the equality level measurement index which is termed the Gini index. Define the realm between the particular allocation curve and ideal equal allocation curve as X, the world below the particular allocation curve as Y . Then the Gini index equals X/(X +Y). The economical meaning of the Gini index is that the in- equality level of the income allocation equals the income used for unequal allocation among total residential income. The Gini index could be a real between 0 and 1. The Gini index for an ideal equal allocation is 0, while the Gini index for a completely unequal allocation is 1. Gini index could be a general index, which reveals a general level of allocation equality. consistent with the United Nation's definition, the Gini index <0.2 represents perfect income equality, 0.2–0.3 relative equality, 0.3–0.4 adequate equality, 0.4–0.5 big income gap, and above 0.5 represents severe income gap. Therefore, the warning level of the Gini index is 0.4. This paper uses the above division of the Gini index to analyze the carbon inequality issue.

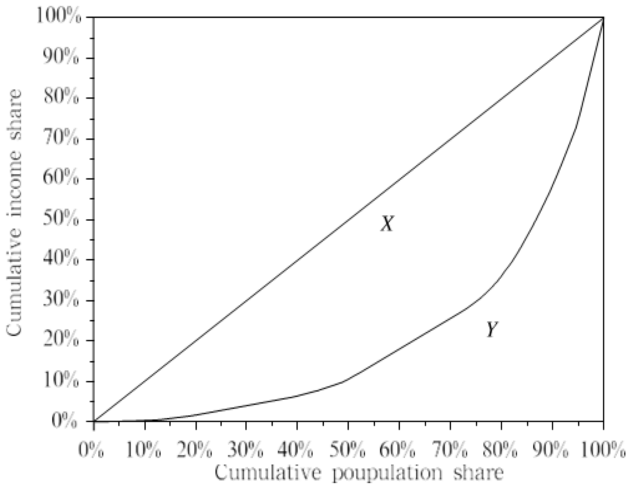

Figure 1 Lorenz curve and Gini index

Developed countries had emitted a large amount of GHG in their industrialization process. The GHG cumulated in the atmosphere, not only enhanced the greenhouse effect but also led to global warming and many other climate changes. Moreover, GHG emitted by developed countries occupied the emission space and made developing countries face a more restricted emission limit. Therefore, the Gini index can also measure the equality situation of different emission allocation plans. In this application of the Lorenz curve and Gini index, the horizontal axis is changed from households to population, while the vertical axis is changed from in- come to emissions. This paper calculates the carbon equality with historical cumulative emission statistics.

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Based on such statistics we will establish the "carbon Lorenz curve" to reflect different countries' un- equal emission allocation levels. According to the "carbon Lorenz curve", we can calculate the "carbon Gini in- dex" to quantitatively measure the emission inequality of different countries.

CARBON LORENZ CURVE AND CARBON GINI INDEX CALCULATION

When investigating different countries' historical cumulative emission situations, this paper focuses on the CO_2 emission from energy activities. *Baumert et al.* [2005] suggested that CO_2 is the main GHG, CO_2 emission from energy activities contributes more than 2/3 of the world GHG total. This paper calculates the historical cumulative emissions by simply adding the emissions, which is a widely used method.

To understand how the historical cumulative emission per capita Lorenz curve is established, first we define the following variables for country *n*:

$G_i{}^n$ is the CO_2 emission in *i* th year of country *n*,

$P_i{}^n$ is the population of country *n* in the *i* th year,

n = is the population of country *n* in the *I* the year,^{n} is the CO_2 emission in *I* the year of country *n*,

Connecting the various countries' points within the reference system with a smooth curve, we established the Lorenz curve supported the historical cumulative emission per capita from I the year to j the year. The carbon Lorenz curve started in 1850 and lists the positions of various countries.

Moreover, we will learn that developing countries have 82% population of the planet, but they contributed merely 25% cumulative emission of the world's total. On the opposite hand, developed countries have 18% population of the globe, but their cumulative emissions account for 75% of the world's total. Based on the carbon Lorenz curve, we can calculate the carbon Gini index. just like the income Gini index calculation, we use two methods. One is that the area method; the opposite is that the mean-variance method The main difference between various area calculation methods is within the calculation of area Y. away is to pick an appropriate fitting Lorenz curve and so use integration to calculate the realm. Differently is to divide Y into several trapezoids. One of the foremost important things in carbon equality and carbon budget is to line the starting year. Many researchers confirmed that the sooner the starting year was, the more historical responsibility is reflected. But they didn't provide a measurement of the assorted starting years' impacts on the historical responsibility. During this paper, we try and use the carbon Lorenz we will see that different calculation methods don't affect the carbon Gini index value much, but the various starting years have a giant influence on the carbon Gini index value. the largest income gap is in Namibia which has the in-come Gini index of 0.74. The Gini index of carbon space allocation is 0.70 if the starting year is 1850. Even if 1990 is employed because the starting year, the carbon Gini index can still reach 0.60 which is on the identical level as countries with the biggest income gaps.

CONCLUSIONS

Economics and sociology are focused more on inequality in terms of economical parameters, especially income inequality since income may be a key factor that determines welfare. Within the field of global climate change, the unequal allocation of carbon emission space is a difficulty of great importance, but the study of the measure of this inequality is very limited in both theory and application. for instance, measuring the in-equality level and trends are going to be beneficial to seem for the basic reason behind the inequality.

During this paper, supported by the historical cumulative emission per capita, the authors established the carbon Lorenz curve and carbon Gini index to quantitatively analyze the emission space allocation inequality issue. Several implications of the historical cumulative emission

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per capita supported the carbon Gini index proposed by the authors during this paper are the following:

1) Historical cumulative emission per capita based carbon Gini index reflects the severe inequality of current emission allocation during a more general way; it helps policymakers and also the public to understand the emission allocation inequality level;

2) carbon Gini index cannot only be wont to analyze the present situation of the emission space allocation inequality but can also use to check the emission space allocation inequality of various future allocation plans, thus it can reveal the equality ramification of various future emission allocation plans and supply guidelines in establishing future allocation plans,

3) by using the carbon Gini index and carbon Lorenz curve, we will further understand the deep-seated factors within the carbon inequality by factor decomposition. The results of the carbon Gini index supported the historical cumulative emission per capita shows that current emission space allocation is severely unequal.

The inequality situation is on the identical level as a rustic with the largest income gap. Within the 1850–2006 calculation periods, the carbon Gini index reaches 0.70 which is much beyond the warning level within the case of income inequality.

Consistent with the principle of UNFCCC, developed countries should take the result in reducing their emissions to redress the unequal situation. The selection of starting year has a great influence on the carbon Gini index. The inequality of carbon space allocation has been concealed because the starting year becomes more modern. However, the even year 1990 is employed because the starting year, the carbon Gini index can still reach 0.60 which is way beyond the warning line.

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