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Role of Environmental Law and International Conventions in Mitigating Climate Change Effects on Food System and Livestock Production

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Abstract. Climate change nowadays is a global threat that is driven by human-induced greenhouse gas emissions and the changeable pattern of global weather. Though there have been previous periods of climatic change since the mid-20th century, humans have had an unprecedented impact on earth's climate system and caused change on a global scale. Consequently, this is affecting the whole food system throughout the world. The utilization of the international legal framework and protocols will have an impact on the human's food system and livestock production. This paper intends to focus on using legal frameworks and protocols to erase the impact of climate change on the food system and livestock production. By using the quantitative research method due to the pandemic situation, this study will explain the broad uses of the Kyoto protocol and Polluter Pays Principle and shall discuss various methods that will help these principles to erase the negative impact of climate change globally. Based on the findings, this paper provides recommendations that could be considered by the developed country to use the legal and social protocols for improving the impact of climate change on the food chain system of humans and livestock production.

Keywords: Climate change, Greenhouse emissions, Livestock production, Kyoto protocols, Polluter pays principle

Abstrak. *Perubahan iklim saat ini merupakan ancaman global yang didorong oleh emisi gas rumah kaca yang disebabkan oleh manusia dan perubahan pola cuaca global. Meskipun telah terjadi periode perubahan iklim sebelumnya, sejak pertengahan abad ke-20 manusia telah memberikan dampak yang belum pernah terjadi sebelumnya pada sistem iklim Bumi dan menyebabkan perubahan dalam skala global. Akibatnya, ini mempengaruhi seluruh sistem pangan di seluruh dunia. Pemanfaatan kerangka hukum dan protokol internasional akan berdampak pada sistem pangan manusia dan produksi ternak. Makalah ini bermaksud untuk fokus pada pemanfaatan kerangka hukum dan protokol untuk menghapus dampak perubahan iklim terhadap sistem pangan dan produksi ternak. Dengan menggunakan metode penelitian kuantitatif karena situasi pandemi, penelitian ini akan menjelaskan penggunaan yang lebih luas dari protokol Kyoto, Polluter Pays Principle dan akan membahas berbagai metode yang akan membantu prinsip-prinsip ini untuk menghapus dampak negatif perubahan iklim secara global. Berdasarkan temuan makalah ini memberikan rekomendasi yang dapat dipertimbangkan oleh negara maju untuk menggunakan protokol hukum dan sosial untuk meningkatkan dampak perubahan iklim sistem rantai makanan manusia dan produksi ternak.*

Kata kunci: *Perubahan iklim, Emisi rumah kaca, Produksi ternak, Protokol Kyoto, Prinsip pencemar membayar*

1. Introduction

Climate change has become one of the hot topics around the world. This climate is changing the whole world's common system in different sectors, and it has become a threat to the global food system. As we know, the climate is the primary determinant of food productivity. The fundamental role of the food system in human welfare is beyond expressive, and nowadays, it has been an issue of concern. The food system of human lives is directly concerned with the climate. Climate change is expected to influence the production and supply of food.[1] Soil production, water, crop, and livestock production are directly affected by changes in climatic factors such as temperature and precipitation and the frequency and severity of extreme events like droughts, floods, and windstorms. In addition, carbon dioxide is fundamental for plant production; rising concentrations have the potential to enhance the productivity of agroecosystems. Food production systems are managed ecosystems. Thus, the human response is critical to understanding and estimating the effects of climate change on production and food supply. The climate change system is also destroying livestock production. The increasing temperature is destroying the normal situation of livestock. It gradually impacts the quality of food, safe water, creating health issues and producing the dairy products of the livestock.[2] The paper will focus on the devastating food chain system of human beings, the threatening situation of this climate change over the human food system, and the harming situation on livestock production.

[1] Max Troell, Rosamond L. Naylor, Marc Metian, Malcolm Beveridge, Peter H. Tyedmers, Carl Folke, Kenneth J. Arrow et al. "Does aquaculture add resilience to the global food system?." *Proceedings of the National Academy of Sciences* 111, no. 37 (2014): 13257-13263.

[2] H. Charles J. Godfray, Ian R. Crute, Lawrence Haddad, David Lawrence, James F. Muir, Nicholas Nisbett, Jules Pretty, Sherman Robinson, Camilla Toulmin, and Rosalind Whiteley. "The future of the global food system." *Philosophical Transactions of the Royal Society B: Biological Sciences* 365, no. 1554 (2010): 2769-2777.

2. Discussion

2.1. Climate Changes on Food Systems and Livestock Productions

Climate change has a tremendous effect on the food system of humans. Generally, the climate is defined as a long-term weather pattern that describes a region. Climate change is referred to a change in the state of the climate that can be identified by changes in the mean and variability of its properties and persists for extended periods of decades or longer. Climate change could occur naturally as a result of a change in the Sun's energy or as a result of persistent anthropogenic forces, such as greenhouse gases, sulfate aerosol, or black carbon,[3] to the atmosphere or through land use change.[4] According to the fourth report of the UN IPCC on climate change, it is indisputable that global warming has serious impacts on the earth, and it is very likely that the increase in greenhouse gas emissions by anthropogenic activities has caused global warming since the mid-20th century. Global climate change is overpowering the food production of the world. Agriculture production is directly dependent on weather and climate change. Possible changes in rainfall rates, change in temperature, and CO^2 concentration is expected to significantly impact crop growth. Worldwide food production is a little cautious with successful adaptation and adequate irrigation due to the brunt of climate transformation, whereas most tropical regions are likely to experience production losses due to rising temperatures.

Food systems are interrelated with the agriculture sector. On the other hand, climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects farming in several ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves), changes in pests and diseases, changes in atmospheric carbon dioxide and ground-level ozone concentrations, changes in the nutritional quality of some foods and changes in sea level. Climate change is already affecting agriculture, with effects unevenly distributed across the world. Future climate change will likely negatively

[3] O. NAS.*Climate change science: an analysis of some key questions*. Washington, DC: National Academy of Sciences National Academy Press, 2001.

[4] Prabhat K. Gupta, C. Sharma, Sumana Bhattacharya, and A. P. Mitra. "Scientific basis for establishing country greenhouse gas estimates for rice-based agriculture: An Indian case study." *Nutrient Cycling in Agroecosystems* 64, no. 1 (2002): 19-31.

affect crop production in low latitude countries, while effects in northern latitudes may be positive or negative. Climate change will probably increase the risk of food insecurity for some vulnerable groups, such as the poor. For example, South America may lose 1–21% of its arable land area, Africa 1–18%, Europe 11–17%, and India 20–40%.

Furthermore, on soil production, climate change has a detrimental effect. Historically, soil seems to be more important for modern human societies than ever before to meet the global demands for food and fiber for increasing population from limited soil resources. The tropical countries are in most vulnerable situation due to the climate system and poor soil system and farmers are living below the margin. The effects of climate change on soils are expected mainly through alteration in soil moisture conditions and increase in soil temperature and CO_2 levels as a result of climate change. The global climate change is projected to have variable effects on soil processes and properties important for restoring soil fertility and productivity. The major effect of climate change is expected through elevation in CO_2 and increase in temperature. Soil formation is controlled by numerous factors including climatic factors such as temperature and precipitation. These parameters of climate influence the soil formation directly by providing biomass and conditions for weathering. Main parameters of climate that directly influence on soil formation are sum of active temperatures and precipitation-evaporation ratio. They determine values of energy consumption for soil formation and water balances in soil, mechanism of organic-mineral interactions, transformation of organic and mineral substances and flows of soil solutions. Stable progressive climate warming lead to irreversible changes in mineral matrix of soils. Changes in external factors of soil formation (temperatures and precipitation) will lead to transformation of internal factors (energy, hydrological, biological). The climate change will increase energy of destruction of soil minerals resulting in simplification of mineral matrix due to accumulation of minerals tolerant to weathering. It will lead loss of soil function for fertility maintenance and greater dependence of on mineral fertilizers.

On crop industry, dry season below temperatures would slow down or even damage crop growth that will decline crop production.[5] Data published by the National Geographic predict that by 2050, climate change will have force global

[5] Robert Mendelsohn. "The impact of climate change on agriculture in Asia." *Journal of Integrative Agriculture* 13, no. 4 (2014): 660-665.

production of corn to reduce by 24%, while rice, potatoes, and wheat will have fallen by 11, 9, and 3%, respectively.[6] Given that along with soybeans, wheat, rice, and corn provide two-thirds of the human caloric intake, such a significant reduction in yields of these crops will undoubtedly severely impact global food security. Currently, figures estimate that crop yields are already being affected by climate change. Global rice yields are, at present, estimated to be falling by 0.3% per year, global wheat yields are estimated to be falling faster, at 0.9% per year.[7] While some studies have reported a beneficial impact of climate change on certain crop yields, it is evident that the overall impact is negative. A study by Boyer uncovered that the world's crop yield has dropped by a huge 70% since 1982 as a result of climate changes. Another study revealed that only 3.5% of global cultivated areas are safe from this impact.

Also, climate change adversely effecting on the water system around the world. The global climate change crisis is inextricably linked to water. Climate change is increasing variability in the water cycle, thus inducing extreme weather events, reducing the predictability of water availability, decreasing water quality, and threatening sustainable development, biodiversity and enjoyment of the human rights to safe drinking water and sanitation worldwide. The science is clear: the global climate change crisis is increasing variability in the water cycle, thus reducing the predictability of water availability and demand, affecting water quality, exacerbating water scarcity, and threatening sustainable development worldwide. These impacts disproportionately affect poor and vulnerable communities and are compounded by contributing factors, including population increase, unmanaged migration, land-use change, reduced soil health, accelerated groundwater extraction, widespread ecological degradation, and biodiversity loss.

Previous research highlighted the impact of climate change on food safety, for instance in diarrheal diseases. This disease cause about 1.9 million deaths per year, mainly among children in poor households in low-income countries, and most are caused by food-borne pathogens, such as *Salmonella* and *Campylobacter*, transmitted

[6] Sarah A. Moore, M. Scott Wells, Russ W. Gesch, Roger L. Becker, Carl J. Rosen, and Melissa L. Wilson. "Pennycress as a cash cover-crop: improving the sustainability of sweet corn production systems." *Agronomy* 10, no. 5 (2020): 614.

[7] Ali Raza, Ali Razzaq, Sundas Saher Mehmood, Xiling Zou, Xuekun Zhang, Yan Lv, and Jinsong Xu. "Impact of climate change on crops adaptation and strategies to tackle its outcome: A review." *Plants* 8, no. 2 (2019): 34.

in animal-derived foods, such as milk, meat, and shellfish.[8] The scientific consensus is that, although individual pathogens will differ widely in epidemiological responses, the net impact of climate change will be a large increase in the burden of infectious diseases.[9] A further risk is that new plant fungal diseases will arise under climate change, and hence, there will be additional mycotoxin risk factors to humans.[10] Scientists have expressed concern that rising incidence of disease will lead to overuse or misuse of pesticides and veterinary medicines, particularly in fisheries.[11]

There are also unavoidable impacts of climate change on livestock production. Livestock products are an important agricultural commodity for global food security because they provide 17% of global kilocalorie consumption and 33% of global protein consumption. The livestock sector contributes to the livelihoods of one billion of the poorest population in the world and employs close to 1.1 billion people. There is a growing demand for livestock products, and its rapid growth in developing countries has been deemed the "livestock revolution". Worldwide milk production is expected to increase from 664 million tons (in 2006) to 1077 million tons (by 2050), and meat production will double from 258 to 455 million tons. Livestock production is likely to be adversely affected by climate change, competition for land and water, and food security at a time when it is most needed.[12] The impacts of climate change on livestock production factors are visible in the current times, temperature affects most of the critical factors for livestock production, such as water availability, animal production, reproduction, and health. Forage quantity and quality are affected by a combination of increases in temperature, CO2, and precipitation variation. Livestock diseases are mainly

[8] Jørgen Schlundt, H. Toyofuku, J. Jansen, and S. A. Herbst. "Emerging food-borne zoonoses." *Revue scientifique et technique-office international des epizooties* 23, no. 2 (2004): 513-534.

[9] Anthony Costello, Mustafa Abbas, Adriana Allen, Sarah Ball, Sarah Bell, Richard Bellamy, Sharon Friel et al. "Managing the health effects of climate change: lancet and University College London Institute for Global Health Commission." *The lancet* 373, no. 9676 (2009): 1693-1733.

[10] M. Cristina Tirado, R. Clarke, L. A. Jaykus, A. McQuatters-Gollop, and J. M. Frank. "Climate change and food safety: A review." *Food Research International* 43, no. 7 (2010): 1745-1765.

[11] S. Solomon, D. Qin, M. Manning, R. B. Alley, T. Bernsten, N. L. Bindoff, A. Chidthaisong et al. "Technical Summary." In *Climate Change 2007: The physical science basis*, pp. 19-91. Cambridge University Press, 2007.

[12] M. Melissa Rojas-Downing, A. Pouyan Nejadhashemi, Timothy Harrigan, and Sean A. Woznicki. "Climate change and livestock: Impacts, adaptation, and mitigation." *Climate Risk Management* 16 (2017): 145-163.

affected by an increase in temperature and precipitation variation. Previous research has shown the detrimental effect of climate change on the poultry production and livestock health.[13]

Firstly, quality of the feeds is affected due to the temperature which is increasing day by day. Increasing of CO2 will affect directly to the growth of the crop yields. This increasing temperature will decrease the nutrient availability of the livestock production.

Secondly, water availability issues will influence the livestock sector, which uses water for animal drinking, feed crops, and product processes. The livestock sector accounts for about 8% of global human water use and an increase in temperature may increase animal water consumption by a factor of two to three. To address this issue, there is a need to produce crops and raise animals in livestock systems that demand less water or in locations with water abundance.

Thirdly, in term of livestock diseases, animal health can be affected directly or indirectly by climate change, especially rising temperatures. The direct effects are related to the increase of temperature, which increases the potential for morbidity and death. The indirect effects are related to the impacts of climate change on microbial communities (pathogens or parasites), spreading of vector-borne diseases, food-borne diseases, host resistance, and feed and water scarcity. Increasing temperature will cause this disease directly.

Fourth, heat stress will decrease the production of milk and other dairy production which is cause by the increasing temperature and climate change. Livestock animals adopt different types of temperature during day and night and this different temperature may cause issues on the production of livestock.

Fifth, in term of nutrient utilization, livestock have several nutrient requirements including energy, protein, minerals, and vitamins, which are dependent on the region and type of animal. Failure to meet the dietary needs of cattle during heat stress affects metabolic and digestive functions. Sodium and potassium deficiencies under heat stress may induce metabolic alkalosis in dairy cattle, increasing respiration rates

Sixth, in term of health issue, several livestock health problems related to climate change. Prolonged high temperature may affect metabolic rate (, endocrine status, oxidative status, glucose, protein and lipid metabolism, liver functionality (reduced cholesterol and albumin), non-esterified fatty acids (NEFA), saliva

[13] M. Melissa Rojas-Downing. *Op.Cit.,*

production, and salivary HCO3 - content. In addition, greater energy deficits affect cow fitness and longevity.

Unfortunately, there is food security effects for decreasing the livestock production. About 842 million people (one in eight people worldwide) went hungry between 2011 and 2013, not receiving enough food to maintain an active and healthy life. Livestock contributes greatly to food security because: (1) they are suppliers of global calories, proteins, and essential micronutrients, (2) they are produced in areas that have difficulty growing crops, (3) most of the feed for livestock is not appropriate for human consumption, and (4) they provide manure for crop production (FAO, 2011). However, there are also concerns that livestock production is detrimental to food security. First, the use of grains as feed in livestock production is a worldwide concern because they are produced for animal feed and not for human consumption. For example, in 2002, one-third of the global cereal harvest was used as livestock feed. The bulk of the livestock feed comes from grasses and legume forage that grows on land not suitable to agriculture, and in many countries, livestock do not receive cereal supplements. In such areas, livestock are a positive contributor to food security.[14]

2.2. Role of Environmental Law and International Conventions Regarding Climate Change

Environmental law has a unique opportunity to set requirements on what steps are necessary to mitigate the effects of climate change to protect us. It is possible to mitigant the whole situation and give a solution to the problem but it is really complex to use those suggestion and make a harmful environment. Environmental law governs how human beings interact with their environment. It covers a wide variety of topics such as air quality, water quality, waste management, chemical safety, contaminant cleanup and hunting and fishing. Many of these areas are relevant to climate change, namely, air quality. Concerning more recent changes, the Supreme Court ruled in 2007 that the EPA needed to determine if carbon dioxide and other greenhouse gases were harmful pollutants under the Clean Air Act. They now regulate them as such. Of course, this type of law doesn't always occur at the level of the Supreme Court. According to this the environmental law and the international courts are making changes to create a better lifestyle and better future without the threat of the climate change. Basically, climate change is

[14] *Ibid.*,

not surrounded only for the food system change of the humans or effecting the livestock production. It is now a global issue and many countries are considering it with a serious note. To prevent the carbon emission and emission of the green house, many international organizations create different legal framework and agreements to prevent this type of carbon emission.

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The Kyoto Protocol is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to reduce greenhouse gas emissions, based on the scientific consensus that (part one) global warming is occurring and (part two) it is extremely likely that human-made CO_2 emissions have predominantly caused it.

[15] M. G. Rivera-Ferre, F. López-i-Gelats, M. Howden, P. Smith, J. F. Morton, and M. Herrero. "Re-framing the climate change debate in the livestock sector: Mitigation and adaptation options." *Wiley Interdisciplinary Reviews: Climate Change* 7, no. 6 (2016): 869-892.

- The protocol is based on the principle of common but differentiated responsibilities: it acknowledges that individual countries have different capabilities in combating climate change, owing to economic development, and therefore puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere.
- The main goal of the Kyoto Protocol is to control emissions of the main anthropogenic (human-emitted) greenhouse gases (GHGs) in ways that reflect underlying national differences in GHG emissions, wealth, and capacity to make the reductions (Grubb, m 2014).

The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC), dealing with greenhouse-gas-emissions mitigation, adaptation, and finance, signed in 2016[16]. The Paris Agreement's long-term temperature goal is to keep the increase in global average temperature to well below 2 °C (3.6 °F) above pre-industrial levels; and to pursue efforts to limit the increase to 1.5 °C (2.7 °F), recognizing that this would substantially reduce the risks and impacts of climate change. This should be done by reducing emissions as soon as possible, in order to "achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases" in the second half of the 21st century. The basic aim of the Paris agreement is to be maintaining the temperature into 2°C, to adapt the increasing situation of the climate change and greenhouse gas emission and balancing the finance of the world between climate change and greenhouse gas emission.

The Paris agreement is one of the most significant agreement which keeps a control over the climate change issues over the countries and formally sets a target of the carbon emissions and keeps a record. Though this agreement cannot force the countries, but the targets should set by the countries, and they must keep track record whether they are crossing it or not. After 2020 presidential election United States withdraw form this Paris agreement stated that there is such nothing about climate change.

Lastly, there is a need for the implementation of "The Polluter Pays Principle". The Polluter Pays Principle imposes liability on a person who pollutes the

[16] Daniel Weisser. "A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies." *Energy* 32, no. 9 (2007): 1543-1559.

environment to compensate for the damage caused and return the environment to its original state regardless of the intent. The polluter pays principle is basically used for those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment[17]. For example, a factory is producing a potentially poisonous substance which is creating greenhouse gas and damaging the environment, so this factory should be responsible for their actions, and they will have to pay this price. It is a guiding principle for creating a sustainable development environment. The polluter pays principle can be applied to greenhouse gas emitters through a so-called carbon price. This imposes a charge on the emission of greenhouse gases equivalent to the corresponding potential cost caused through future climate change, thus forcing emitters to internalize the cost of pollution. It is a safer way to minimize the emission of greenhouse gas and creating a pressure towards the emitters for paying money.

Although the agricultural sectors per year emit 20% greenhouse gas, it was totally ignored by the whole system, and it is helping the climate change and destroying its own system. The food security is only surrounding towards the agricultural sectors and the crop yields, but this food insecurity has impacted the human health and increasing the human diseases. Environmental law can suggest the whole concept how to clear the harmful impact of climate change, but no one want to go through the whole complicated process. The right to food only explains that food is the necessity of the human to live but didn't include that food insecurity is increasing by the climate change. Food and agriculture organization only works for the right of the agricultural side not their exploitation by the climate change. The Kyoto protocol under UNFCCC, is all sufficient to reduce the greenhouse gas emission and carbon emission but it is also failed and there is no news to retrieve it back. United States resigned from the Paris agreement, whose basic aim to set the world temperature in to 2-degree Celsius. After not taking seriously this agreement by the most powerful states, the whole concept of the climate change is become a joke to everyone. Impact of climate change over water is only explains the glacier melting not the topic of the safe water issue. The impact of the climate change is literally overshadowed by the recent threat towards the whole world Covid-19, and everyone is normalizing the concept of climate change. Humans is more affecting the world more than the climate change; the food sector and the

[17] Sanford E. Gaines. "The polluter-pays principle: from economic equity to environmental ethos." *Tex. Int'l LJ* 26 (1991): 463.

livestock production is equally harmful for the world, and it also emit the equal amount of the gas and carbon and it is neglecting by the scientist and the given importance to the impact of the climate change. Scientists cannot find the proper solution for the livestock problem, so creating problems will increase the threating situation, will not help those people who actually wants to solve it.

3. Conclusion and Recommendations

Livestock production is one of the most impactful sides of the agricultural field and contributes a large amount of food. The destroying nature of climate change is changing the lifestyle and impacting the two most important sectors of the live food system of humans and livestock production. The uses of the failure protocols and the conventions can bring light and life to this neglecting part. International laws and conventions have to focus on the rejected protocol, which can change the rate of carbon emissions and greenhouse gas. After all the support of international laws, conventions, and developed countries, we can really make a greenhouse effect-less world that will be a healthier one.

As recommendations, the system of the polluter pays principle should be mandatory for developed, developing, and underdeveloped countries. The main objective of this principle is to target those countries that emit a lot of carbon and greenhouse and collect money from them in exchange for these emissions. Those who run the high gas emission factory must pay the money in exchange for this. The polluter pays principle must maintain by the developed country, and the UN and UNFCCC must pressure them for this because if the developed country follows this principle, then the developing country will pay according to them, and the emission of carbon gas by the factory will come to a maintained situation. The system of the Kyoto principle should be brought back. It has the power to stop and minimize the emission of carbon and greenhouse gas. The failure of this principle means the failure of those efforts who want to stop the climate change impact. The international courts and ICC must make new laws regarding food security and punish those countries that try to destroy the agriculture industry due to their emitted gas. The food and agricultural organization must make new regulations regarding food insecurity due to climate change and must present them to the UN assembly. Lawmakers must give thought to the necessity, fairness, and cost-effectiveness of their regulations, which is not always simple. But the cost

which brings the environmental law strong then the cost is worth it. New laws should be regulated and should be made by the developed country and should punish those wrongdoer people regarding climate change; it will prevent others from creating carbon and greenhouse gas.

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