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## **INTERNATIONAL LEGISLATIVE FRAMEWORK FOR SEQUESTRATION OF ORGANIC CARBON IN AGRICULTURAL SOIL AS A CLIMATE CHANGE TOOL**

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### **Abstract**

This article is dedicated to the sequestration of organic carbon in agricultural soil as a potentially effective tool in the battle against climate change. The protection of soil and climate are closely linked and interrelated. The article presents the most important international treaties in the area of battling climate change and links them to the protection of agriculture soil. International treaties that aim to the protection of soil are also reviewed by the author.

### **Key words**

climate change, adaptation, mitigation, carbon sequestration, agriculture land

### **Introduction**

Nowadays there is no longer a debate that climate change is real and represents the biggest threat humanity has ever faced. This fact is regularly confirmed by the World Economic Forum, which publishes the Global Risk Report annually, where the biggest threats to the global economy are identified. This year the fourteenth edition has been released and as three biggest threats in terms of likelihood have been identified three that are closely linked to climate change: extreme weather events, failure of climate change mitigation and adaptation and natural disasters (The World Economic Forum, 2019). It is now possible to argue that climate change is happening due to the amount of greenhouse gases (GHG) in the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report stated that it is “**extremely likely** that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together” (IPCC, 2014). According to IPCC human activities are estimated to have caused approximately 1°C of global warming and that it is likely to reach rise of temperature about 1.5°C between 2030 and 2052 if we do not change our world rapidly (IPCC, 2018). Atmospheric concentration is measured in parts per million CO<sub>2</sub> equivalents (ppm CO<sub>2e</sub>). This amount is rising significantly since pre-industrial levels (i.e. before 1800) when the CO<sub>2</sub> concentration was around 280 ppm to the level of around 410 ppm (Batjes, 1996). The opposite trend has been observed in the concentration of carbon in the soil. The soil of the whole Earth amount to 2157-2293 gigatonnes of carbon (Batjes, 1996). This means that the soil carbon pool is 3.3 times the size of the atmospheric pool (around 760 Gt) and 4.5 times the size of the biotic pool (560 Gt). However, through soil degradation, much of the natural soil carbon stocks have been lost, which is equivalent to the

loss of 42 to 78 gigatonnes of carbon (Lal, 2004). This article elucidates the process of soil carbon sequestration, which could serve as a solution to both of these problems.

## **Material and Methods**

The paper uses the secondary sources of information. e.g. scientific papers, statistical data and related legal acts. Information were proceeded through the method of analyse, synthesis, deduction, induction and scientific abstraction.

## **Results and Discussion**

### ***1 Sequestration of Organic Carbon in Agricultural Soil***

Despite the fact that the soil carbon pool is huge, the soil degradation caused that lot of natural soil carbon have been lost. It was concluded that “carbon sink capacity of the world’s agricultural and degraded soil is 50 to 66% of the historic loss of 42 to 78 gigatonnes of carbon” (Lal, 2004). Fortunately, this process is not necessarily irreversible and there is a solution to this issue. Carbon sequestration, in general, is a transfer of atmospheric CO<sub>2</sub> into the other global pools including oceanic, pedologic, biotic and geological strata to reduce the net rate of increase in atmospheric CO<sub>2</sub> was termed as carbon sequestration (Lal, 2008). “Biological sequestration includes direct removal of CO<sub>2</sub> from the atmosphere through land-use change (LUC), afforestation, reforestation, revegetation, carbon storage in landfills and practices that enhance soil carbon in agriculture (cropland management, grazing land management)” (IPCC, 2014). These definition are rather broader and this article aims to focus only on sequestration of organic carbon in soil, which could be described as an increase in the soil carbon content, which resulted from a change in management and at the same time, additional carbon is held on to in the soil and is separated from other parts of the ecosystem (Powlson, 2011). Basically, there is a huge carbon pool on earth which is slowly emptying and at the same time, excess carbon keeps building in the atmosphere. Such conversion of the GHG into the organic matter can arrest land degradation, restore the soil’s chemical and physical stability, improve fertility and simultaneously it serves the purposes of the mitigation and adaptation to adverse effects of climate change. That is why many consider it to be a win-win opportunity (Lehmann, 2009). However, some authors point out that carbon sequestration can continue only for few next decades and after carbon builds up in the ground further gains will be slowed or even halted (Van Groeningen et al., 2014). Globally, around one-third of the soil of arable land is in agriculture so agriculture soil have a great potential to become a carbon sink. Enlarging soil carbon stocks have numerous advantages for agricultural systems, such as improved soil and water quality, increased crop yields, increased nutrient, reduced plant water stress, enriched species diversity of soil biota, reduced risk of soil erosion (Lal). Essentially, there are two groups of options for carbon sequestration: abiotic and biotic. Abiotic carbon sequestration does not involve the intervention of living organisms. Thus in agriculture is more on point to speak about biotic carbon sequestration. The biotic sequestration is based on the managed intervention of higher plants and microorganisms in removing CO<sub>2</sub> from the atmosphere. There are many options of practices of biotic carbon sequestration available: improved crop residue management; extended crop rotations; planting cover crops, perennial crops and winter crops; soil erosion control; improved water and nutrient management; increased utilization of cultivation systems that require minimal tillage (i.e., reduced tillage); crop rotation (Ussiri and Lal, 2017). I see carbon sequestration also as a tool that could help overcome challenges closely linked to climate change such as adapting to adverse effects of climate change and helps to produce more food for a growing world

population, changes in the dietary of wealthier classes in countries like India and China by increasing quantity and quality of the soil.

## ***2 International Agreement on Climate Action***

This part of the article describes international treaties relating to climate change. Focus is given to the provision with regards to land use, managing soil carbon and carbon sequestration. First of all, I would like to focus on treaties dealing with climate change and later other relevant treaties will be analyzed. The three most important international treaties in the field of climate change law: the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto protocol) and Paris Agreement will be discussed.

### ***2.1 The UNFCCC***

The UNFCCC was adopted at the Rio Earth Summit<sup>1</sup> on 9 May 1992 and entered into force on 21 March 1994. At the moment it has 197 parties. To this day the UNFCCC is still perceived as a crucial point for the creation of the overall framework for international efforts to address the issue of climate change. Parties proclaimed that they are concerned that human activities increased the concentration of GHG and that this incensement will result in additional global warming and might adversely affect natural ecosystems. The UNFCCC sets the ultimate objective in the battle against climate change in article 2.<sup>2</sup> This ultimate objective could be divided into three separate targets: stabilizing GHG concentration, slowing rates of climate change and assuring that food production is not threatened and sustainable development is allowed. First of them was later termed as “quasi-target” while the second was termed as “quasi-time-table” because of the ambiguous wording used (Bodansky, D., 1993). The UNFCCC does not deal directly with carbon sequestration, however, it contains some provision related to the soil management. To give you an idea, the preamble states that Parties to the UNFCCC are “aware of the role and importance in terrestrial and marine ecosystems of sinks and reservoirs”.<sup>3</sup> However, the preamble is not legally binding and generally state the background and purposes of the international agreement. The UNFCCC stipulated that the Parties should take precautionary measures to prevent and minimize the causes of climate change and mitigate its adverse effect and that they should be cost-effective. Such measures should be comprehensive and should “cover all relevant sources, sinks, and reservoirs of greenhouse gases”.<sup>4</sup> As previously stated, the soil represents the second largest natural reservoir of carbon in the world, so this article addressed, although not explicitly, also soil.

The commitments enshrined in the UNFCCC could be divided into three types: General commitments for all Parties to the UNFCCC, Specific commitments on sources and sinks for Parties listed in Annex I to the UNFCCC and Specific commitments on financial resources and technology transfer for Parties listed in Annex II to the UNFCCC. While speaking about carbon sequestration as a tool to mitigate climate change, the most important commitments are those intended for Annex I Parties. They could be divided into three main commitments. First of all, these Parties are under the obligation to adopt national policies and take measures

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<sup>1</sup> The United Nations Conference on Environment and Development (UNCED).

<sup>2</sup> Article 2 of UNFCCC: “The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”

<sup>3</sup> Paragraph 5 of the Preamble to the UNFCCC.

<sup>4</sup> Paragraph 3 of Article 3 of the UNFCCC.

aimed to limit GHG emissions and enhance its GHG sinks and reservoirs.<sup>5</sup> The second commitment is represented by stricter requirements governing reporting. Parties listed in Annex I to the UNFCCC were obligated to make its initial communication within six months of the entry into force of the UNFCCC to each of these Parties, while other Parties are obligated to do so within three years.<sup>6</sup> Thirdly, these communications shall be more detailed (also in the terms of sinks of GHG) than communications of other Parties.<sup>7</sup>

## 2.2 The Kyoto Protocol

The second important international treaties in the battle against climate change is the Kyoto protocol adopted on 11 December 1997 on the third Conference of the Parties (COP3) and entered into the force on 16 February 2005. To this day it has 192 Parties. The Kyoto protocol represents a milestone since it has been the first and to this date, the only international agreement setting out legally binding obligations to reduce GHG emissions – termed “QELRCs” - quantitative emission limitation and reduction commitments, but only on Parties included in Annex I to the UNFCCC. Another commitment *inter alia* put an obligation on such Parties to implement and/or elaborate policies and measures to protect and enhance sinks and reservoirs of GHG, to promote sustainable forms of agriculture in light of climate change considerations, to research, promote, and develop carbon dioxide sequestration technologies.<sup>8</sup> The Kyoto protocol introduces two brand new and innovative flexibility mechanisms: Clean development mechanism (CDM)<sup>9</sup> and International emission trading (ET).<sup>10</sup> Especially the CDM was important for carbon sequestration. It allows Annex I Parties to implement emission reduction measures in other countries and to consider the emission reductions achieved with regard to their obligation under the Kyoto Protocol (Boer, 2017). The disadvantage is that the projects aimed at fostering carbon sequestration in agricultural soil have not been accepted as a CDM project, while afforestation and reforestation have been accepted.<sup>11</sup> The different situation occurred when different flexibility mechanism – joint implementation. Based on the Articles of the UNFCCC<sup>12</sup> the first COP decides to establish a pilot phase for two kinds of activities under the joint implementation. Either between Annex I Parties or if Annex I Party decided to do so on a voluntary basis, then between such a Party and the Party of the UNFCCC not included in Annex I.<sup>13</sup> Parties with aim to reducing GHG emissions or improve GHG removal by sinks are allowed to invest in any other Party,<sup>14</sup> if such activities were accepted by all Parties.<sup>15</sup> In the regime of joint implementation all land use, land use change, and forestry (LULUCF) projects are allowed. It is noteworthy to mention that the KP was *ex-post* marked as a success since all 36 countries with QELRC were in compliance with their commitments at the end of the first commitment period (Shishlov, 2016). It is possible to conclude that “Kyoto protocol highlights that carbon sequestration in agricultural soil by land management practices can contribute to mitigating climate change” (Piccolo, 2012), however not in its entirety.

<sup>5</sup> Subparagraph (a) of Paragraph 2 of Article 4 of the UNFCCC.

<sup>6</sup> Paragraph 5 of the UNFCCC.

<sup>7</sup> Subparagraphs (b) and (c) of Paragraph 2 of Article 4 of the UNFCCC.

<sup>8</sup> Subparagraph (a) of Paragraph 1 of Article 2 of the Kyoto protocol.

<sup>9</sup> Article 12 of the Kyoto protocol.

<sup>10</sup> Article 17 of the Kyoto protocol.

<sup>11</sup> See Decision 5/CMP.1.

<sup>12</sup> Paragraph 3 of Article 3 of the UNFCCC; Subparagraph (a) of Paragraph 2 of Article 4 of the UNFCCC; Subparagraph (d) of Paragraph 2 of the UNFCCC.

<sup>13</sup> Subparagraph 1 (a) of Decision 5/CP.1.

<sup>14</sup> Subparagraph 1 (b) of Decision 5/CP.1.

<sup>15</sup> Subparagraph 1 (c) of Decision 5/CP.1

### 2.3 Paris Agreement

Third and in my opinion the most important international treaty dealing with climate change is the Paris agreement, which was adopted at COP21 on 12 December 2016 and entered into the force on 4 November 2016. To this day it has 197 Parties. The Paris agreement was adopted under the UNFCCC and enhances implementation of the UNFCCC, including its objective. Nonetheless the Paris agreement sets its own new objective, which is located in Article 2, which enshrines three separate but, in fact, very closely related “sub-objectives.” The first relates to the long-term temperature goals – to hold an increase in the global average temperature to well below 2 degrees Celsius and to pursue efforts to limit its increase to 1.5 degrees Celsius.<sup>16</sup> The second sub-objective is forcing on increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience, low GHG emissions development.<sup>17</sup> It is important to stress out that this should be carried out in a manner that does not threaten food production. The aim to make finance flows consistent with a pathway towards low GHG emissions and climate-resilient development represents the third sub-objective of the PA.<sup>18</sup> Despite the fact that the Paris agreement does not explicitly mention agriculture, it is possible to identify provision relating to it. First of all, Parties recognized the fundamental priority of safeguarding food security and the particular vulnerabilities of the food production system to the adverse effects of climate change (regrettably) only in the non-binding Preamble to the Paris Agreement. Important article from the author’s point of view is article 5 concerning conserving and enhancing sinks and reservoirs of GHG. On the one hand, this article imposing an obligation on Parties to “take action to conserve and enhance, as appropriate, sinks and reservoirs of GHG.”<sup>19</sup> Biomass, forests, ocean, other terrestrial, coastal and marine ecosystems included. And on the other hand, this article encourages parties to implement and support the existing framework under the Convention with regard to reducing emissions from deforestation and forest degradation (Klein, 2017). According to Climate Focus, this article could be understood as a support to sequestration options that are not ecosystem and biomass-based such and carbon capture and storage (Climate Focus, 2015). The heart of the Paris agreement are nationally determined contributions. They represent the switch from a top-down approach, used mostly in the Kyoto protocol to the “hybrid managerial approach” (Klein, 2017). Each party is obligated to “prepare, communicate and maintain successive NDC that it intends to achieve.”<sup>20</sup> They represent each Parties’ climate action plan. It is up to each party to consider what will be contained in these NDCs. Before adopting of the Paris agreement Parties were invited to communicate their intended NDC well in advance of the COP 21<sup>21</sup> and they later become Party’s NDC unless the Party decided otherwise. By analysis made by Food and Agriculture Organization of the United Nations, agriculture and LULUCF “are among the most frequently included sectors included in the intended NDCs (Strohmaier, 2016). It is already known that all NDCs combined are not yet enough to achieve the long-term goal of holding an increase in the global average temperature to well below 2 degrees Celsius, and definitely not enough to pursue efforts to limit its increase to 1.5 degrees Celsius (Elzen, 2015).

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<sup>16</sup> Subparagraph (a) of Article 2 of the Paris agreement.

<sup>17</sup> Subparagraph (b) of Article 2 of the Paris agreement.

<sup>18</sup> Subparagraph (c) of Article 2 of the Paris agreement.

<sup>19</sup> Paragraph 1 of Article 5 of the Paris Agreement.

<sup>20</sup> Paragraph 2 of Article 4 of the Paris agreement.

<sup>21</sup> Subparagraph (b) of Paragraph 2 of Decision 1/CP.19.



### ***3 International Agreements Supporting the Idea of Carbon Sequestration***

Despite the fact that there is no doubt that previous three international treaties represent the principal legislation for the management climate change issue, none of them deals with the soil explicitly. Therefore other international and regional multilateral treaties for land use and ecosystem management need to be analyzed in order to provide a full picture of a comprehensive framework of international law dealing with soil protection and carbon sequestration in soil (Hannam, 2004). Therefore the second part of the article will be devoted to the Convention on Biological Diversity (CBD), United Nations Convention to Combat Desertification (UNCCD), and Sustainable Development Goals (SDG). This part of the article analyzes how they contribute to international governance of sustainable soil use and protection and how they govern the issue of carbon sequestration in soil.

#### ***3.1 Convention on Biological Diversity***

The CBD was adopted at the Rio Earth Summit on 5 June 1992 and entered into force on 29 December 1993. Currently, it has 196 parties. To this day represents the most comprehensive legislative regime of international rules for the protection of biological diversity. The conservation and sustainable use of biodiversity, including soil biodiversity, is promoted by CBD (Wolff and Kaphengst, 2017) by enshrining them as the main objective.<sup>22</sup> Many of the provision are interlinked with soil protection, mainly as a habitat for the species, for example by Article 8 each of the Party shall “promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings.”<sup>23</sup> In general, it is possible to state that “the environmental, economic and social benefits of conserving biodiversity outlined under Articles 5–10 of the CBD could assist when framing domestic legislation to manage soil carbon sequestration” (Hannam, 2004). The benefits of increasing of the soil carbon were already mentioned above, so only very simply: enlarging soil carbon stocks have many positive effects and one of them is improving habitats for living organisms in the soil, such as microbes, bacteria, fungi as well as macro fauna (earthworms, termites, ants) (Voroney, 2018). Soil biodiversity is crucial for the wellbeing of natural ecosystems and also for the agricultural production (e.g. higher yields).

#### ***3.2 The United Nations Convention to Combat Desertification***

The Rio Earth Summit brought very important action of the United Nations with regard to sustainable development – Agenda 21. Two years later, in 1994, the UNCCD was adopted, building upon chapter 12 of Agenda 21. This convention entered into force on 26 December 1996 and to this day it has 197 Parties. According to UNCCD land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities is termed as desertification.<sup>24</sup> The main objective of the UNCCD promotes the reduction of land degradation by combating desertification, which should involve strategies aimed at improving the productivity of land, rehabilitation, and conservation of land.<sup>25</sup> Desertification and climate change are closely interrelated. Desertification, on the one hand, reduces a potential sink carbon sink by releasing carbon stored in the vegetation and disturbed the soil. On the other hand, global warming caused by climate change speeds up to the process of the desertification. On this basis, it is possible to agree with A. Imeson (2012) who expressed that “desertification is both an impact and driver of climate change”. With that said, it is clear that this creates a synergistic relationship between the obligations of the

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<sup>22</sup> Article 1 of the CBD.

<sup>23</sup> Subparagraph (d) of Article 8 of the CBD.

<sup>24</sup> Subparagraph (a) of Article 1 of the UNCCD.

<sup>25</sup> Article 2 of the UNCCD.

UNCCD and obligations of the UNFCCC (Hilme and Kelly, 1993). The World Meteorological Organization, among others, is focusing on research on the interactions between climate change and desertification by e.g. advocating enhanced observing systems and enhancing climate prediction capability (World Meteorological Organization, 2007). At the moment the IPCC is preparing special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems that is scheduled to be adopted in second half of the year 2019 which should provide the most recent scientific knowledge about this issues and the relationship between them. All Parties to the UNFCCC and the UNCCD should incorporate procedures for the creation and/or restoration of soil sink within a national legislative framework based on the fact that it could serve as an important tool to meet obligations arising from these two international treaties.

#### ***4 The United Nations Sustainable Development Goals***

The Sustainable Development Goals (SDGs) are part of the “2030 Agenda for Sustainable Development”. This agenda was adopted in 2015 and provides a shared blueprint for peace and prosperity for people and the planet. Despite the fact that SDGs are not binding, countries are expected to take ownership and establish a national framework for achieving the 17 Goals. Healthy soil carbon cycling is a key element for achieving several of SDGs:

- SGD 1 – End poverty in all its forms everywhere. Poor people, especially in developing countries, rely on agriculture as a primary source of food;
- SDG 2 – Zero hunger. This SDG is underpinned by the need for fertile soil to be able to produce more food for more people;
- SDG 13 – Climate action. Carbon sequestration offers a suitable solution for mitigation. Smart agriculture should be also implemented in order to adapt to the adverse effects of climate change;
- SDG 15 – Life on land. In this area, healthy soil represents the essential and necessary basis for life – both for animals and plants. Healthy soil produces healthier food and better nutrition.

#### **Conclusions**

Nowadays climate change represents the biggest threat that humankind and emissions of GHG show no peaking. The Paris agreement has brought new hope but so far in only the unconditional NDCs are implemented, the emission gap increases to 15 GtCO<sub>2</sub>e. The gap in the case of the 1.5°C target is 29 GtCO<sub>2</sub>e and 32 GtCO<sub>2</sub>e respectively (United Nations Environment Programme, 2018). This gap can be only addressed by upscaling and acceleration of far-reaching, multilevel and cross-sectoral mitigation (IPCC, 2018). Agriculture and other land use accounts for between 20 and 25 percent of global greenhouse gas emissions, which is a pretty high number. However, the agriculture could provide a tool that could help to achieve the net-zero carbon emissions worldwide, which according to Paris agreement should be achieved in the second half of this century.<sup>26</sup> This tool or rather mechanism is carbon sequestration, which could lead to incensement of the carbon in the soil. Despite the fact that that carbon sequestration can continue only for few next decades and after carbon builds up in the ground further gains will be slowed or even halted, it could provide enough time to reach peaking of GHG emissions.

In this article, the main international treaties in the area of battling climate change (UNFCCC, Kyoto protocol, Paris agreement) were described with remarks to soil protection and carbon

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<sup>26</sup> Paragraph 1 of Article 4 of the Paris Agreement.



sequestration. Two more international treaties dealing with soil protection (CBD and UNCCD) were also described. Actions taken in accordance with them complement each other and could help mitigate climate change and on the other hand help to, not only prevent the further degradation of soil but also help restore quality and quantity of healthy soil agricultural soil due to the fact that soil carbon has a direct correlation with soil quality. The importance of soil quality is projected to only rise due to because of the projected increase in demand for food and bioenergy that will only put more pressure on agriculture. So far states have been reluctant to implement this tool in their national legislation. Only a few of them could be found worldwide – Australia could be marked as one of the best examples. Another countries should follow and develop policies and regulations to take full advantage of carbon sequestration in the agriculture soil, because there are more than enough places where the carbon could be stored cost-effectively, with enormous economic benefits, while preventing the costs of runaway global climate change. Nevertheless, without global-scale restoration, it will be impossible to sequester enough global needs.

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