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Sumário

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The relevance of transnational standards to climate-smart agriculture and food security: insights from Kenya and Nigeria*

A relevância dos padrões transnacionais para a agricultura inteligente em relação ao clima e a segurança alimentar: perspectivas do Quênia e da Nigéria

Habib Sani Usman**

Abstract

Apart from providing food and feeds, agriculture is also a source of employment and economic growth in many African countries especially Kenya and Nigeria. However, agricultural practices such as crop and livestock production are the major sources of greenhouse gas emissions as well as factors that cause climate change in Kenya and Nigeria. At the same time, Kenya's and Nigeria's agricultural practices are threatened by the impacts of climate change, which manifests as droughts, flooding and heat waves. In order to address the impacts of climate change on agriculture and to curtail agriculture-induced climate change, Kenya and Nigeria devised climate-smart agricultural strategies. These climate-smart agricultural strategies are supported by standards drawn from law and policy. Using a doctrinal research method which employs a descriptive and analytical study of discourse (where data is gathered through physical and electronic library), this article argues that the global nature of climate change and its local consequences warrants complementing Kenyan and Nigerian national climate-smart agriculture laws and policies with a combination of standards drawn from more than one jurisdiction, with sources in both legal and non-legal norms agreed upon by state actors and non-state actors. These standards simply described as transnational standards, if effectively applied, could promote climate-smart agriculture and food security especially in Kenya and Nigeria.

Keywords: climate-smart agriculture; Kenya; Nigeria; food security; transnational standards.

Resumo

Além de fornecer alimentos e rações, a agricultura também é uma fonte de emprego e crescimento econômico em muitos países africanos, especialmente no Quênia e na Nigéria. No entanto, práticas agrícolas como a produção de culturas e a criação de gado são as principais fontes de emissões de gases de efeito estufa, além de fatores que contribuem para as mudanças climáticas no Quênia e na Nigéria. Ao mesmo tempo, as práticas agríco-

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las nesses países estão ameaçadas pelos impactos das mudanças climáticas, que se manifestam por meio de secas, inundações e ondas de calor. Para enfrentar os impactos das mudanças climáticas na agricultura e reduzir a contribuição da agricultura para essas mudanças, o Quênia e a Nigéria desenvolveram estratégias de agricultura inteligente em relação ao clima (climate-smart agriculture). Essas estratégias são apoiadas por padrões estabelecidos no âmbito da legislação e da política pública. Utilizando um método de pesquisa doutrinária, que emprega um estudo descritivo e analítico do discurso (com coleta de dados em bibliotecas físicas e eletrônicas), este artigo defende que a natureza global das mudanças climáticas e suas consequências locais exigem que as leis e políticas nacionais de agricultura inteligente em relação ao clima no Quênia e na Nigéria sejam complementadas por um conjunto de padrões oriundos de mais de uma jurisdição, abrangendo normas jurídicas e não jurídicas acordadas por atores estatais e não estatais. Esses padrões, aqui denominados padrões transnacionais, se aplicados de forma eficaz, poderiam promover a agricultura inteligente em relação ao clima e a segurança alimentar, especialmente no Quênia e na Nigéria.

Palavras-chave: agricultura inteligente em relação ao clima; Quênia; Nigéria; segurança alimentar; padrões transnacionais.

1 Introduction

The Intergovernmental Panel on Climate Change (IPCC)[1] describe agriculture as a sector of the economy that produces food crops, industrial crops, livestock, fisheries, biofuels, and pastures.[2] Apart from providing food, agriculture also serves as a vital source of employment, revenue, and the main source of gross domestic product (GDP) in many countries, including Kenya, and Nigeria.[3] In Kenya for instance, more than 10 million people rely on agriculture for their livelihood.[4] In addition, up to 33% of Kenya's GDP is accrued from agriculture in 2022.[5] In Nigeria, agriculture serves as a means of livelihood for about 70% of the population, and it also complements the petroleum sector in generating revenue.[6] In both countries, the agricultural sector is made of up livestock, poultry and aquaculture and a variety food crops (such as rice, yams, beans, millet, sorghum and cassava) as well as some cash crops mainly consisting of cocoa, cotton, groundnut and palm oil.[7]

However, it should be noted that the cultivation of certain types of legumes and cereals requires the ploughing of soil by high-energy consuming machinery, which leads to more greenhouse gas (GHG)[8] emissions and eventually climate change.[9] Similarly, successful crops production require fertile soil,[10] and soil fertility is enhanced by the application of both industrial fertilizers, such as ammonia (NH3) and (NH4), and non-industrial fertilizers, such as manure derived from fermentative digestion by cows, horses, and sheep.[11] The application of industrial and non-industrial fertilizers

[1] The IPCC was established in 1988 as a scientific unit of the United Nations for the purpose of assessing climate change-related impacts, and to provide policymakers with advice on how to mitigate and adapt to the impacts of climate change. See https://www.ipcc.ch/.

[2] PORTER, John R.; HOWDEN, Mark; SMITH, Peter. Considering agriculture in IPCC assessments. *Nature Climate Change*, v. 7, n. 10, p. 680-683, 2017.

[3] USMAN, H. S. *The development of agriculture-focused adaptation laws in Kenya, Nigeria and South Africa*. South Africa: North West University, 2022.

[4] UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT. *Agriculture, Food and Water Security*. Washington: USAID, 2023. Available at: ttps://www.usaid.gov/kenya/agriculture-food-and-water-security#:~:text=The%20agricultural%20sector%20is%20the,percent%20of%20the%20rural%20population. Access on: 12 June 2023.

[5] FAO. *Kenya at a glance*. 2023. Available at: https://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/. Access on: 12 June 2023.

[6] FAO. *Nigeria at a glance*. 2021. Available at: https://www.fao.org/nigeria/fao-in-nigeria/nigeria-at-a-glance/en/. Access on: 12 June 2023.

[7] FAO. *FAO in Kenya*. 2019. Available at: http://www.fao.org/kenya/en/. Access on: 12 June 2023. See also Federal Ministry of Agriculture, Water resources and rural development, Abuja 2001 http://extwprlegs1.fao.org/docs/pdf/nig149296.pdf5.

[8] GHGs is a combination of Water vapour (H2O), Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Ozone (O3), Chlorofluorocarbon CFCs, Perfluoro carbons (PFCs) and Sulphur Hexafluoride (SF6). See Bernstein, et. al., climate change 2007: synthesis report.» (2008).

[9] CÁRCELES RODRÍGUEZ, Belén *et al.* Conservation agriculture as a sustainable system for soil health: a review. *Soil Systems*, v. 6, n. 4, 2022.

[10] VERSCHUUREN, Jonathan. Agriculture, climate disasters, and the law. *In*: LYSTER, Rosemary; VERCHICK, Robert R. M. (ed.). *Research handbook on climate disaster law*: barriers and opportunities. London: Edward Elgar Publishing, 2018. p. 297-312.

[11] IPCC. *Climate Change 2007*: impacts, adaptation and vulnerability. 2007. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf. Access on: 10 May 2023; THORNTON, P. K.; HERRERO, M. Climate change adaptation in mixed crop–livestock systems in developing countries. *Global Food Security*, v. 3, p. 99-107, 2014

causes GHG emissions and can lead to climate change.[12] Likewise, livestock production, especially cattle, are a source of GHG (methane) emissions as well as climate change.[13] For example, through a process known as "enteric fermentation," cattle rearing is responsible for approximately 14.5% of the total global GHG emissions annually.[14]

Given that most agricultural practices such as crops production and livestock production in Kenya and in Nigeria are dependent on climate-sensitive resources such as rainfall, stable temperature and fertile soil, changes in climatic systems which usually manifest as droughts, desertification,[15] heat waves and rising sea levels affects crop yield and animal productivity. For example, in 2019, a decrease in crops yields and livestock productivity in the semi-arid region of Northern Nigeria were attributed to incidence of rising temperatures and a decline in rainfall.[16] By implication, the impacts of climate change on crops and livestock could have also fed into loss of livelihood, household income, and most importantly, food insecurity in Kenya and in Nigeria. Accordingly, food security is achieved when there is: "[t]he stability of food availability, access to adequate and nutritious food for all people, use of food to meet all socio-physiological demands, and availability of sufficient and high-quality food".[17]

As further defined by the Food and Agriculture Organization (FAO) of the United Nations, food security is: "[w]hen all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to suit their dietary needs and food preferences for an active and healthy life".

The dimensions to food security as given by the FAO (most importantly, access to sufficient, use and availability of quality food at the time of need) can not be realized in the wake of the climate change impacts particularly droughts, non-favourable temperature and poor soil nutrients, among others. Therefore, mitigation and/or adaptation measures are required to address the impact of climate change on agriculture and food security. In the context of agriculture, mitigation and adaptation strategies are collectively described as climate--smart agriculture (CSA) strategy.

The concept of CSA evolved as and effective option of curtailing agriculture-based GHG emissions, while also promoting the resilience of agriculture against the manifestations of climate change especially droughts and fluctuating temperature,[18] as well as a means of promoting food security in climate change hotspots.[19]

In arid and semi-arid regions of Africa (Kenya and Nigeria) CSA strategies are for instance presented in the of form droughts-tolerant crops and heat resistant as well as high yielding crop varieties.[20] As well, cereal-groundnut intercropping practices that involves for instance, cultivating groundnuts with maize, millet

[12] In 2005, industrial fertilizers were reportedly confirmed to be responsible for about 58% of global anthropogenic emissions. This is much compared to the net flux of carbon dioxide (CO2) emissions (other than emissions from the use of fossil fuel). According to the IPCC, the global warming potential (GWP) value of fertilizers is 23 times higher than CO2. Similarly, the application of industrial fertilizers such as N2O account for about 60% of global anthropogenic emissions. See REID, Susanna *et al*. Vulnerability and adaptation to climate risks in Ontario agriculture. *Mitigation and Adaptation Strategies for Global Change*, n. 12, p. 609-637, 2007. Apart from the higher GWP of fertilizers, it has been argued that excessive application of fertilizers on the soil can introduce heavy metals into the soil. The presence of heavy metals in the soil can contaminate surface and groundwater, thus leading to the depletion of arable lands. See Tilman, et. al., Nature 418, no. 6898 (2002): 671-677; Glibert, and Burkholder. «The Ecology of harmful algae, 2006 pp. 341-354.

[13] SPERANZA, Chinwe Ifejika. Resilient adaptation to climate change in African agriculture. *Studies*, v. 54, n. 3, 2010.

[14] See FAO 2023 https://www.fao.org/news/story/en/item/197623/icode/.

[15] PARKER, Louis *et al*. Vulnerability of the agricultural sector to climate change: the development of a pan-tropical Climate Risk Vulnerability Assessment to inform sub-national decision making. *PloS one*, v. 14, n. 3, 2019.

[16] JIBRILLAH, A. M.; JA'AFAR, M.; CHOY, L. K. Monitoring vegetation change in the dryland ecosystem of Sokoto, northwestern Nigeria using geoinformatics. *The Indonesian Journal of Geography*, v. 51, n. 1, p. 9-17, 2019.

[17] WORKU, Alemitu; TEREFE, Melkamu. Effect of climate change on food security. *Ratarstvo i Povrtarstvo*, v. 60, n. 1, p. 20-25, 2023.

[18] LIPPER, Leslie *et al*. Climate-smart agriculture for food security. *Nature Climate Change*, v. 4, n. 12, p. 1068-1072, 2014. PARTEY, Samuel T. *et al*. Developing climate-smart agriculture to face climate variability in West Africa: challenges and lessons learnt. *Journal of Cleaner Production*, v. 187, p. 285-295, 2018; NTINYARI, Winnie *et al*. Nitrogen use efficiency trends for sustainable crop productivity in Lake Victoria basin: smallholder farmers' perspectives on nitrogen cycling. Environmental Research Communications, v. 4, n. 1, 2022.

[19] The IPCC described an area as a climate change hotspot based on the interplay of spatial planning, climatic conditions and other factors including geographic location and geologic variations. See MALAK, Dania Abdul *et al*. *Adapting to Climate Change*. Frankfurt: Springer, 2017; PACHAURI, Rajendra K. *et al*. *Fifth Assessment Report*. Genebra: IPCC, 2014.

[20] MICHLER, Jeffrey D. *et al*. Conservation agriculture and climate resilience. *Journal of Environmental Economics and Management*, v. 93, p. 148-169, Jan. 2019.

or sorghum are examples of CSA practices embarked by farmers in Kenya and Nigeria.[21] Additionally, farmers in arid and semi-arid regions of Kenya and Nigeria resort to the use of farm and animal manure, and composts as organic fertilizers, as viable alternative to industrial fertilizers, which are noted for their global warming potentials.[22]

Other CSA practices employed by farmers in Kenya and Nigeria include soil nutrient management techniques such as cover cropping and composting.[23] Apart from increasing the organic nutrient inputs of soil, these techniques also obviate the need for using synthetic fertilizers, which aside from being costly for small scale farmers to obtain, are the main source of GHG emissions.[24]

All the aforementioned illustrations of CSA come along with numerous benefits. For example, the adoption of drought and flood-tolerant crops could lead to less use of the costly non-renewable and eco-depleting agrochemicals to support crops, and by extension it means less GHG emissions. In the same regard, Pretty is of the opinion that CSA practices such as sustainable land use management as exemplified by minimum tillage and organic production, minimizes the emission GHG.[25]

In addition, CSA is noted for its effectiveness to harness "limited natural resources while increasing farmers' income and improving the standard of living without an adverse effect on the environment, biodiversity, and human well-being."[26] The successful implementation of CSA practices hinges on a set of regulatory actions formulated and implemented by decision-makers at the national level and international level. At the national level for instance, Kenya and Nigeria made attempts to promote CSA methods through regulatory frameworks.

In Kenya, the concept of CSA in Kenya is supported by policy framework know as the Kenya CSA Strategy Framework 2017. The main aim of the CSA Strategy Framework is to promote the resilience of the agricultural sector against climate change impacts, while at the same time seeking to minimize the agriculture--induced GHG emissions without affecting food security and income from agriculture.[27] More specifically, the Kenyan CSA Strategy Framework was formulated to: "[…] create an enabling regulatory and institutional framework; and address cross-cutting issues that adversely impact climate-smart agriculture in Kenya."[28]

To achieve its objectives, the Kenyan CSA Strategy Framework identifies some crucial resources that support agriculture that require urgent attention against the impacts of climate change such as water, temperature and land.[29] In addition to curtailing the impacts of climate change on the resources that support agriculture, the Kenyan CSA Strategy Framework is formulated to facilitate the development of a legal and institutional framework that can oversee the implementation of all CSA practices in Kenya.[30]

Consequently, the Kenyan CSA Strategy Framework is relied upon by stakeholders in the agriculture sector both at the local and national level of government for directions in identifying the most suitable agricultural production methods against existing or impending cli-

[21] KAMARA, Alpha Y. *et al.* Maize–soybean intercropping for sustainable intensification of cereal–legume cropping systems in northern Nigeria. *Experimental Agriculture*, v. 55, n. 1, p. 73-87, 2019.

[22] TABE-OJONG, Martin Paul Jr. *et al.* Organic soil amendments and food security: evidence from Cameroon. *Land Degradation & Development*, v. 34, n. 4, p. 1159-1170, 2023.

[23] SNAPP, S. S. *et al.* Evaluating cover crops for benefits, costs and performance within cropping system niches. *Agronomy Journal*, v. 97, n. 1, p. 322-332, 2005.

[24] FAO, Hague Conference on Agriculture, Food Security and Climate Change.

[25] PRETTY, J. Agricultural sustainability: concepts, principles and evidence. *Philosophical Transactions of the Royal Society B*: Biological Sciences, v. 363, n. 1491, p. 447-465, 2008.

[26] ADESINA, O. S.; LOBOGUERRERO, A. M. Enhancing food security through climate-smart agriculture and sustainable policy in Nigeria. *In*: LEAL FILHO, W.; LUETZ, J.; AYAL, D. (ed.). *Handbook of climate change management*: research, leadership, transformation. Cham: Springer International Publishing, 2021. p. 1-17.

[27] REPUBLIC OF KENYA. *Kenya Climate Smart Agriculture Strategy 2017-2026*. Nairobi: Ministry of Agriculture, Livestock and Fisheries, 2017. Available at: https://adaptation-undp.org/sites/default/files/resources/kenya_climate_smart_agriculture_strategy.pdf. Access on: 12 June 2023.

[28] REPUBLIC OF KENYA. *Kenya Climate Smart Agriculture Strategy 2017-2026*. Nairobi: Ministry of Agriculture, Livestock and Fisheries, 2017. Available at: https://adaptation-undp.org/sites/default/files/resources/kenya_climate_smart_agriculture_strategy.pdf. Access on: 12 June 2023.

[29] REPUBLIC OF KENYA. *Kenya Climate Smart Agriculture Strategy 2017-2026*. Nairobi: Ministry of Agriculture, Livestock and Fisheries, 2017. Available at: https://adaptation-undp.org/sites/default/files/resources/kenya_climate_smart_agriculture_strategy.pdf. Access on: 12 June 2023.

[30] REPUBLIC OF KENYA. *Kenya Climate Smart Agriculture Strategy 2017-2026*. Nairobi: Ministry of Agriculture, Livestock and Fisheries, 2017. Available at: https://adaptation-undp.org/sites/default/files/resources/kenya_climate_smart_agriculture_strategy.pdf. Access on: 10 Jan. 2024.

mate change impacts.[31] For example, the Kenyan Water Institute, Kenyan School of Agriculture, Kenyan Institute of Organic Farming, and the Kenyan Meat Training Institute, are guided by the Kenyan CSA Strategy Framework in operationalizing CSA integrated farming and pastoral production systems.[32]

However, unlike in Kenya where CSA practices are supported by a dedicated framework, in Nigeria CSA practices are regulated by a fragmented climate change -related policy and legal instruments.[33] These policy and legal instruments include National Adaptation Strategy and Plan of Action for Climate Change in Nigeria (NASPA-CCN)[34] Nigeria Climate Change Policy Response and Strategy (NCCPRS)[35] The NASPA-CCN and the NCCPRS are intended to promote climate change actions by fostering a low-carbon and sustainable growth of all sectors of Nigeria's economy including agriculture.[36] In other words, stakeholders in Nigeria's climate change governance are guided by the NASPA-CCN and the NCCPRS in formulating suitable response strategy for agriculture against the impact of climate change particularly CSA methods. On the basis of the NASPA-CCN and the NCCPRS, some CSA projects were implemented across Nigeria. For example, the Pro-Resilience Action (PROACT) projects were implemented in Adamawa and Borno States (located in North East) of Nigeria, in order to strengthened the resilience of farmers.[37] These set of farmers who are mostly engaged in the farming of crops (such as cassava, yam, sweet potatoes, groundnut, cotton, rice, and maize) and the rearing of cattle, poultry and goats, were supported with farm inputs (water pumps, improved seeds), and were given flexible financing services.[38] In addition farmers in Borno State were trained under the PROACT scheme on techniques that promotes terrace farming in rocky areas, and how to control soil erosion and preserve soil moisture contents, as well as how to improve the nutrients of some crops such as sorghum and maize.[39]

As explained, CSA practices serve dual purposes, namely promoting climate-friendly environment and enhancing food security. However, the global nature of climate change impacts such as desertification, flooding and drought may have cross-border effects.[40] This makes it necessary to also shift the regulatory focus for issues such as CSA practices, as national (and perhaps regional) regulatory frameworks alone could not adequately facilitate CSA practices. In other words, CSA actions poorly implemented by one state could have transboundary implications for food security in other parts of the world. Therefore, to address agriculture--induced climate change at the regional and national levels, actions and measures need to be implemented in a systematic, coherent, and effective way.

Put differently, regulatory standards with transnational outlook are required to promote climate change actions including CSA strategies. In the context of this paper, it is relevant to state that transnational standards could also effectively deal with the inequalities between developed countries and developing countries especially Kenya and Nigeria. Likewise it pertinent to highlight the urgency and necessity of transforming to a trans nationalized regulatory framework in the face of the climate change and food crisis, especially in the context of the Anthropocene, where human actions have unprecedented impacts in terrestrial systems.

31 REPUBLIC OF KENYA. *Kenya Climate Smart Agriculture Strategy 2017-2026*. Nairobi: Ministry of Agriculture, Livestock and Fisheries, 2017. Available at: https://adaptation-undp.org/sites/default/files/resources/kenya_climate_smart_agriculture_strategy.pdf. Access on: 10 Jan. 2024.

32 REPUBLIC OF KENYA. *Kenya Climate Smart Agriculture Strategy 2017-2026*. Nairobi: Ministry of Agriculture, Livestock and Fisheries, 2017. Available at: https://adaptation-undp.org/sites/default/files/resources/kenya_climate_smart_agriculture_strategy.pdf. Access on: 10 Jan. 2024.

33 ADESINA, O. S.; LOBOGUERRERO, A. M. Enhancing food security through climate-smart agriculture and sustainable policy in Nigeria. *In*: LEAL FILHO, W.; LUETZ, J.; AYAL, D. (ed.). *Handbook of climate change management:* research, leadership, transformation. Cham: Springer International Publishing, 2021. p. 1-17.

34 See http://csdevnet.org/wp-content/uploads/NATIONAL-ADAPTATION-STRATEGY-AND-PLAN-OFACTION.pdf.

35 See https://climatepolicydatabase.org/policies/climate-change-policy-response-and-strategy.

36 OLAJIDE, B. E.; QUADRI, M. O.; OJAKOROTU, V. Climate change, human security and good governance in Nigeria. *African Renaissance*, v. 15, n. 3, p. 173-196, 2018.

37 The PROACT CSA projects were launched in Nigeria in 2016 by Oxfam Nigeria in collaboration with the EU with the aim of enhancing food security by helping farmers to boost agricultural productivity notwithstanding ensuing challenges and risks such as climate change. See PROACT 2016 https://proactnigeria.com/.

38 See https://cgspace.cgiar.org/handle/10568/106101; https://www.fao.org/3/ca5416en/CA5416EN.pdf.

39 See https://www.fao.org/3/ca5416en/CA5416EN.pdf

40 CHALLINOR, Andy *et al*. Transmission of climate risks across sectors and borders. *Philosophical Transactions of the Royal Society A*: Mathematical, Physical and Engineering Sciences, v. 376, n. 2121, 2018. HEDLUND, Johanna *et al*. Quantifying transnational climate impact exposure: new perspectives on the global distribution of climate risk. *Global Environmental Change*, v. 52, p. 75-85, 2018.

2 Transnational standards for climate change actions

The term 'transnational' denotes an all-inclusive form of governance occurring simultaneously at various levels and executed by various state actors and non- state actors [...]" [41] It is often described as:

> [c]ollaboration between divers' stakeholders from the private, public and non-government sectors who, acting together towards commonly agreed (or mutually negotiated) goals, hope to achieve far more collectively, than individually.[42]

In other words, climate change actions (mitigation and adaptation), became firmly established as a subject of transnational governance during the 2015 Paris Agreement. Following the Paris Agreement, both climate change mitigation and adaptation were considered to have local, subnational, national, regional and international dimensions.[43] Though, there were elements of transnational governance in climate change actions existing prior to the Paris Agreement. In other words, there has been collaborative and supportive action among states actors and other non-state actors with a view to mutually develop rules, standards and best practices for addressing the impacts of climate change.[44] An example of this supportive and collaborative effort can be seen in the efforts made by Europe and North America to remove barriers against the adjudication of transboundary environmental disputes in national courts, and to ensure that transboundary environmental impacts were reflected in national regulatory and administrative decision-making process.[45] Similarly, transnationalized climate change action governance existed in instances where national governments were joined by other non-state actors such as corporations and non-governmental organisations (NGOs) in the implementation of climate change actions.[46] In the same way, the transnationalization of climate change action governance has occurred when regional organisations collaborated with each other and with foreign nations in adaptation planning and implementation processes.[47]

Compared with international law-based climate change standards, which are made effective through compliance and implementation by state actors,[48] transnational standards obviates the need to ensure compliance by state actors.[49] In principle, transnational standards neither require restrictive rules and extensive observance, nor "formal recognition and enforcement by courts of customary international law." [50] In other words, rules and obligations are increasingly becoming informal under a transnational arrangement, and enforcement does not entirely occur through sanctions. [51]

In addition, transnational standards has created a fertile ground for the diversification of national commitments in the international climate change legal regime, which creates alternative forms of cooperation between actors. [52] For example, the argument canvassed at the 2002 World Summit on Sustainable Development (WSSD) was that the responsibility for governing global

41 KOTZÉ, Louis J. *Global environmental governance*: law and regulation for the 21st century. London: Edward Elgar Publishing, 2012.

42 GUNNINGHAM, Neil. The new collaborative environmental governance: the localization of regulation. *Journal of Law and Society*, v. 36, n. 1, p. 145-166, 2009.

43 DZEBO, Adis; STRIPPLE, Johannes. Transnational adaptation governance: An emerging fourth era of adaptation. *Global Environmental Change*, v. 35, p. 423-435, 2015.

44 SAND, Peter H. International environmental law after Rio. *Eur. J. Int'l L.*, v. 4, n. 377, 1993.

45 STEIN, Robert E. The OECD Guding Principles on Transfrontier Pollution. Ga. *J. Int'l & Comp. L.*, v. 6, n. 245, 1976.

46 This is mostly the case in for instance the United States where subnational governments (cities and local authorities), have begun to address climate change by playing key roles in adapting and mitigating the impacts of climate change on biodiversity. For example, see ENGEL, Kirsten H. Policy innovation under dynamic, adaptative federalism and democratic experimentalism compared: lessons for federalism and climate change adaptation policy. *Arizona Legal Studies Discussion Paper*, n. 16-01, 2016.

47 FARBER, Daniel; CARLARNE, Cinnamon. *Climate change law*: concepts and insights. California: Foundation Press, 2017.

48 This has been demonstrated for instance, in the legal framework that seek to regulate fisheries, potable water and endangered species. CHARLES, Anthony T. Fishery conflicts: a unified framework. *Marine Policy*, v. 16, n. 5, p. 379-393, 1992.

49 Sometimes climate change actions under a regional legal framework are weakened by jurisdictional limits. MACE, Mary Jane. Adaptation under the UN Framework Convention on Climate Change: the international legal framework. *In*: ADGER, W. Neil *et al.* (ed.) *Fairness in adaptation to climate change*. Cambridge: MIT Press, 2006. p. 53-76.

50 SHAFFER, Gregory; BODANSKY, Daniel. Transnationalism, unilateralism and international law. Transnational Environmental Law, v. 1, n. 1, p. 31-41, 2012.

51 Instead of deploying direct sanction such as disciplinary measures and dismissal in regulating behaviour, transnational standard regime uses economic tools such as financial penalties and suspension of rights and privileges in regulating the conducts of both state actors and non-state actors. See for example, NIGHTINGALE, Andrea J. Power and politics in climate change adaptation efforts: struggles over authority and recognition in the context of political instability. *Geoforum*, v. 84, p. 11-20, 2017.

52 DI GREGORIO, Monica *et al.* Multi-level governance and power in climate change policy networks. *Global Environmental Change*, v. 54, p. 64-77, 2019.

issues should be shared between public and private actors.[53] This argument led to the formation of a Type II partnership between public and private actors to deliver sustainability.[54] This means that, under a transnational regime, there is stronger coordination and collaboration among institutions vested with climate change actions at all levels of governance. This leads to a more pronounced interconnectedness and interdependence among institutions.[55]

Understanding the shared dimension of climate change actions under a transnational regime is important in analysing "the quality of governance, its effectiveness and its legitimacy."[56] Equally important, the multidimensional nature of climate change action governance under a transnational regime has resulted in a focused standard-setting mechanism with a high level of institutionalization and a well-coordinated regulatory framework at the national and regional levels.[57] One way to understand the role and effectiveness of climate change actions under a transnational regime is to review the composition of actors involved.

3 Actors and promoters of transnational standards for climate change actions

As previously emphasized, climate change actions under a transnational regime involve agreements and interactions between state actors and a variety of non-state actors, such as intergovernmental organizations, transnational corporations and networks, and regional organizations.[58] These agreements and interactions could, for instance, be presented in the form of industry codes and standards,[59] environmental stewardship,[60] and reporting schemes.[61] Both state and non-state actors under a transnational arrangement play different roles and perform different functions in climate change actions. Some of these functions and roles, among others, include the facilitation of the law-making process and ensuring the implementation and enforcement of obligations.[62]

However, it should be noted that the role and function of each actor under a transnational regime are generally limited to the rights and obligations granted to them by the legal instruments that establish them.[63] For example, state actors create, adopt, and implement international legal principles and rules for climate-change actions according to the rights and obligations imposed on them by their constitutive instruments.[64] It is also within the purview of the role and function of state

[53] See https://www.globalpolicy.org/social-and-economic-policy/the-environment/the-johannesberg-summit.html.

[54] Some of examples of type II partnership include Global Village Energy Partnership, European Union Energy Initiative for Poverty Eradication and Sustainable Development, Renewable Energy and Energy Efficiency Partnership, etc. This has been explained in academic circles few years prior to emergence of the most recent climate change action legal instrument-the Paris Agreement. See for example, WIENGES, Sebastian. *Governance in global policy networks*: individual strategies and collective action in Five Sustainable Energy-related Type II Partnerships. Frankfurt: Peter Lang, 2010.

[55] KOTZÉ, Louis J. *Global environmental governance*: law and regulation for the 21st century. London: Edward Elgar Publishing, 2012.

[56] ROGGERO, Matteo; KÄHLER, Leonhard; HAGEN, Achim. Strategic cooperation for transnational adaptation: Lessons from the economics of climate change mitigation. *International Environmental Agreements*: Politics, Law and Economics, v. 19, n. 4-5, p. 395-410, 2019.

[57] BENZIE, Magnus; PERSSON, Åsa. Governing borderless climate risks: moving beyond the territorial framing of adaptation. *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 369-393, 2019.

[58] ANDONOVA, Liliana B. Boomerangs to partnerships?: explaining state participation in transnational partnerships for sustainability. *Comparative Political Studies*, v. 47, n. 3, p. 481-515, 2014. TREIB, Oliver; BÄHR, Holger; FALKNER, Gerda. Modes of governance: towards a conceptual clarification. *Journal of European Public Policy*, v. 14, n. 1, p. 1-20, 2007.

[59] A prime example of codes and standards is the 'ecolabels,' which are labels on products that attest to their environmental attributes. Ecolabels are found in more than 450 products in about 25 industrial sectors spread across 197 countries. See http://www.ecolabelindex.com.

[60] Environmental stewardship means the "responsible use and protection of the natural environment through conservation and sustainable practices, e.g., reduced waste of water, best landscape management, etc. BERRY, Robert James (ed.). *Environmental stewardship*. London: A&C Black, 2006. v. 56.

[61] Reporting scheme allows both private and public organisations to improve their environmental performance through continuous self-assessment methods. Reporting scheme has been found effective in providing basis for decision-making. Scholar has further explained this. For example, see DOBBS, Stevie; VAN STADEN, Chris. Motivations for corporate social and environmental reporting: New Zealand evidence. *Sustainability Accounting, Management and Policy Journal*, v. 7, n. 3, p. 449-472, 2016.

[62] KOTZÉ, Louis J. Arguing global environmental constitutionalism. *Transnational Environmental Law*, v. 1, n. 1, p. 199-233, 2012.

[63] DRUMBL, Mark A.; UHLÍŘOVÁ, Kateřina. Actors and lawmaking in international environmental law. *In:* FITZMAURICE, Malgosia *et al.* (ed.). *Research handbook on international environmental law*. Massachusetts: Edward Elgar Publishing, 2010. p. 6-8.

[64] DAMROSCH, L. F. *et al. International law, cases and materials*. 4. ed. St. Paul: West Group, 2001.

actors to establish international organizations and allow other non-state actors to participate in international legal processes.[65]

As participants and observers representing international organizations, non-state actors play an important role in shaping the development of transnational standards for climate change actions by identifying key issues that require international legal action.[66] Non-state actors also promote transnational standards for climate change actions through collaboration with state actors in the implementation of climate change actions principles and rules adopted at the national, international, and regional levels.[67]

The convergence of state actors and non-state actors in promoting standards for climate change actions is especially important in promoting CSA. The next section of this paper provides a detailed illustration of the roles and functions of actors under a transnational regime and how each actor could influence CSA.

3.1 Intergovernmental organisations

Intergovernmental organizations are entities created by states through ponderous but protracted deliberations and negotiations.[68] Intergovernmental organizations, such as the United Nations Organization, are vested with an international legal personality, as derived from their constitutive documents.[69] The membership of intergovernmental organizations such as the Organization for Economic Co-operation and Development (OECD), the United Nations Development Programme (UNDP), and the United Nations Environmental Programme (UNEP), among others, are both diffused and fragmented, cutting across global, regional, and bilateral levels.[70] Intergovernmental organizations serve as a platform for collaboration and coordination with other entities, such as non-state actors (for instance, matters of climate change action governance).[71] In other words, intergovernmental organisations provide the platform by which: "[t]he steering mechanism of [climate change] governance can be carried forward by providing necessary linkages between policymakers, local stakeholders and experts."[72]

These linkages are vital for the promotion of CSA practices at the regional and national level.

In addition, intergovernmental organizations contribute to the development of CSA through standard settings, technical research, and development.[73] According to Cameron *et. al.*, intergovernmental organizations are important in the context of climate change actions (including CSA) because they provide best practices and standards for climate change actions through workshops, meetings, and information databases.[74]

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[65] Other non-state actors in this context could be natural persons and juristic persons (e.g., corporations). DOWNS, George W.; ROCKE, David M.; BARSOOM, Peter N. Is the good news about compliance good news about cooperation? *International organization, v.* 50, n. 3, p. 379-406, 1996.

[66] According to Agenda 21, non-state actors that participates in the formation and development of transnational standards include but not limited to the scientific and technological community; non-profit-making environmental groups and associations (NGOs); private companies and business concerns; legal organisations; the academic community; and individuals, farmers and trade unions. See UN Department for Economic and Social Affairs, Division for Sustainable Development 2001, *Agenda 21 Section III*. SANDS, Philippe; PEEL, Jacqueline. *Principles of international environmental law*. Cambridge: Cambridge University Press, 2012.

[67] GARNER, Maria. Transnational alignment of nongovernmental organizations for global environmental action. *Vand. J. Transnat'l L.*, v. 23, n. 653, 1990.

[68] DOWNS, George W.; ROCKE, David M.; BARSOOM, Peter N. Is the good news about compliance good news about cooperation? *International organization, v.* 50, n. 3, p. 379-406, 1996.

[69] DRUMBL, Mark A.; UHLÍŘOVÁ, Kateřina. Actors and lawmaking in international environmental law. *In:* FITZMAURICE, Malgosia *et al.* (ed.). *Research handbook on international environmental law*. Massachusetts: Edward Elgar Publishing, 2010. p. 6-8.

[70] KIM, Rakhyun E. Is global governance fragmented, polycentric, or complex?: the state of the art of the network approach. *International Studies Review*, v. 22, n. 4, p. 903-931, 2020; BIERMANN, F. *et al.* The fragmentation of global governance architectures: a framework for analysis. *Global Environmental Politics*, v. 9, n. 4, p. 14-40, 2009.

[71] For example, the Kyoto Protocol (Compliance Procedure: Art. VII, para.5) also requires NGOs to submit relevant factual and technical information as part of compliance procedure for adaptation measures. See also THACHER, Peter S. Multilateral cooperation and global change. *Journal of International Affairs*, v. 44, n. 2, p. 433-455, 1991.

[72] ROSENAU, James N. Global governance as disaggregated complexity. *In:* BA, Alice; HOFFMANN, Matthew J. (ed.). *Contending perspectives on global governance*: coherence and contestation. London: Routledge, 2005. p. 131-153.

[73] ULFSTEIN, Geir. International framework for environmental decision-making. *In*: FITZMAURICE, Malgosia; ONG, David M.; MERKOURIS, Panos. *Research Handbook on International Environmental Law*. London: Edward Elgar Publishing, 2010. p. 26-47; HÉRITIER, Adrienne; LEHMKUHL, Dirk. The shadow of hierarchy and new modes of governance. *Journal of Public Policy*, v. 28, n. 1, p. 1-17, 2008.

[74] It is also important to note that intergovernmental organisations add almost 45% of global adaptation initiatives followed by NGOs, which contributes about 30% of adaptation initiatives globally. Accordingly, this indicates importance of intergovernmental

Above all, intergovernmental organizations play a crucial role in setting the stage for the development of climate change action laws and policies at the local level. This role is illustrated by the activities of the United Nations Organization through its subsidiary agencies such as the UNEP and UNFCCC, among others. [75] In particular, the UNFCCC serves as a:

> [f]ramework instrument that sets the parameters for global discourse and provides an essential forum for dialogue and decision-making that enables countries to deal with the impacts of climate change, thus making it the principal global institution governing climate change actions.[76]

Through the UNFCCC, party states were able to establish rules and commitments for climate change action, including knowledge-sharing frameworks and guidelines.[77] In relation to CSA strategies and actions, the UNFCCC generally requires all parties to:

> [p]romote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases [...] in all relevant sectors, including the [...] agriculture [...] sector[s].[78]

Aside from the UNEP and the UNFCCC, there are some intergovernmental organizations that operate outside the United Nations Organization, which have been established by environmental treaties such as the Global Gas Flaring Reduction Partnership[79] and Renewable Energy Policy Network for the 21st century (REN 21).[80] These intergovernmental organizations also promote climate change actions standards that are relevant to CSA.

3.2 Transnational institutions

In addition to intergovernmental organizations, transnational institutions also promote standards and best practices (through sanctions) that are relevant for climate change actions.[81] Such institutions include the International Council for Local Environmental Initiatives (ICLEI),[82] and International Network for Environmental Compliance and Enforcement (INECE).[83] According to Galaz *et. al.*, these transnational institutions have specific features, such as the "absence of hierarchical authority and strong coordination" that enables them to promote standards and best practices for climate change actions as well as CSA.[84] For example, the INECE strongly recommends practices, such as improved pasture and grazing management in grasslands, to achieve the global goal of carbon sequestration in the agricultural sector.[85] Accordingly, these practices would not only protect the environment from agriculture-induced climate change through CSA, but they are also expected to: "[h]ave the collateral benefit of strengthening global food security by increasing market stability, providing agricultural employment opportunities, and

organisations in transnational adaptation. CAMERON, Peter D. The Kyoto Process: past, present, and future. *In:* CAMERON, Peter D. *et al. Kyoto*: from principles to practice. California: Kluwer Law International, 2001. p. 3-23. DZEBO, Adis; STRIPPLE, Johannes. Transnational adaptation governance: An emerging fourth era of adaptation. *Global Environmental Change*, v. 35, p. 423-435, 2015.

75 In addition to the UNFCCC and UNEP, there are some important intergovernmental organisations for protecting the environment serving as subsidiary bodies of the United Nations Organization such as the Commission on Sustainable Development, the International Law Commission, and the UN Economic Commission for Europe. MENSAH, Chris. The United Nations Commission on Sustainable Development. *In:* WERKSMANN, Jacob. *Greening International Institutions*. London: Routledge, 2017. p. 21-37.

76 Some of these programs aimed at supporting climate change actions include special assistance funds aimed at helping Least Developed Countries (LDCs) draft climate change actions plans. CONTIADES, Xenophon; FOTIADOU, Alkmene. Social rights in the age of proportionality: global economic crisis and constitutional litigation. *International Journal of Constitutional Law*, v. 10, n. 3, p. 660-686, 2012.

77 The Nairobi Work Programme on Adaptation is an example of national rules and commitments that evolved courtesy of the UNFCCC platform. See https://www4.unfccc.int/sites/nwpstaging/Pages/NWP-knowledge-resources.aspx.

78 Art 4(1) (c) UNFCCC. See also Art 10(c) Kyoto Protocol.

79 See https://www.worldbank.org/en/programs/gasflaringreduction.

80 See http://www.ren21.net.

81 BÄHR, Cordelia Christiane. Greenhouse gas taxes on meat products: a legal perspective. *Transnational Environmental Law*, v. 4, n. 1, p. 153-179, 2015; DRUMBL, Mark A.; UHLÍŘOVÁ, Kateřina. Actors and law-making in international environmental law. *In:* FITZMAURICE, Malgosia *et al.* (ed.). *Research handbook on international environmental law*. Massachusetts: Edward Elgar Publishing, 2010. p. 6-8.

82 See www.iclei.org.

83 See https://inece.org/.

84 GALAZ, Victor *et al.* Polycentric systems and interacting planetary boundaries: emerging governance of climate change–ocean acidification–marine biodiversity. *Ecological Economics*, v. 81, p. 21-32, 2012.

85 Carbon sequestration is simply explained as a natural or artificial means of removing carbon dioxide from the atmosphere and conserving it in solid or liquid form. Carbon sequestration could serve as a mitigation as well as an adaptation strategy for agriculture. See VERSCHUUREN, Jonathan. Towards a regulatory design for reducing emissions from agriculture: lessons from Australia's carbon farming initiative. *Climate Law*, v. 7, n. 1, p. 1-51, 2017.

boosting the sustainability of vulnerable agricultural systems."[86]

In addition, transnational institutions use a range of mechanisms and instruments, such as information sharing, capacity building and implementation, and rule setting, to promote standards and best practices for climate change actions.[87] Although these mechanisms and instruments are not considered equivalent to the traditional regulatory mechanism, they could nevertheless serve as benchmark standards and means of shaping behaviour or ensuring compliance with targets, goals, and norms, as well as soft laws,[88] in the context of CSA.[89]

3.3 Regional organisations

Regional organizations exist to foster political and economic integration among sovereign states or entities that happen to be within a defined geopolitical sphere.[90] Regional organizations can foster political and economic integration because they: "[a]re closer to the people they represent and are able to understand the common concerns of member countries, thus making it be easier to make decisions and take actions in respect of shared natural resources."[91]

In sharp contrast to international environmental organizations, regional organizations are able to govern climate change actions in a better manner. Given that there are few states involved in a region, this means there is less bureaucracy, and decision-making is simplified, faster, and more effective.[92]

Thus, with the aid of well-established institutions, regulations, and policies, regional organizations are able to promote standards and best practices for climate change actions, especially CSA. By virtue of transnational cooperation (i.e., calls for joint implementation and collective enforcement among Territorial Communities), standards and best practices for climate change actions developed by regional organizations are transposed to the transnational community.[93] The European Committee for Standardization (CEN-CENELEC), [94] as well as the proposed European Union (EU) 2030 climate framework Land Use, Land Use Change, and Forestry (LULUCF) Regulation[95] offer the best examples of regionally based harmonized, flexible, and well-established climate change action governance frameworks that accommodate various actors, institutions, and networks among member states.[96] The Common

86 See http://www.fao.org/3/i3325e.pdf.

87 Information sharing for example, can perform crucial adaptation governance functions by framing issues, setting agendas, defining what counts as responsible or effective action, offering inspiration, and providing a means of benchmarking achievements. See for instance information sharing principle statement of the 'Climate Group.' See https://www.theclimategroup.org/sites/default/files/2021-10/Under2%20MOU_English_2021.pdf.

88 Soft laws, (also called quasi-legal instruments) are so described because their legal binding force is virtually absent or somehow weak compared to the traditional law (hard laws). Examples of soft law among others include resolutions and declarations of the UN General Assembly, statements, principles, code of practice of the COP of the UNFCCC, etc. DRUZIN, Bryan H. Why does soft law have any power anyway? *Asian Journal of International Law*, v. 7, n. 2, p. 361-378, 2017.

89 BOWEN, Frances; TANG, Samuel; PANAGIOTOPOULOS, Panos. A classification of information-based environmental regulation: voluntariness, compliance and beyond. *Science of The Total Environment*, v. 712, 2020.

90 SPANDLER, Kilian. *Regional organizations in international society*: ASEAN, the EU and the politics of normative arguing. London: Palgrave Macmillan, 2018.

91 BLANCO, Elena; RAZZAQUE, Jona. *Globalisation and natural resources law*: challenges, key issues and perspectives. Cheltenham: Edward Elgar Publishing, 2011.

92 BENZIE, Magnus; PERSSON, Åsa. Governing borderless climate risks: moving beyond the territorial framing of adaptation. *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 369-393, 2019. ELLINAS, Antonis A.; SULEIMAN, Ezra N. Supranationalism in a transnational bureaucracy: the case of the European Commission. *Journal of Common Market Studies*, v. 49, n. 5, p. 923-947, 2011.

93 KHENG-LIAN, Koh; ROBINSON, Nicholas A. Strengthening sustainable development in regional inter-governmental governance: lessons from the ASEAN way. *Singapore Journal of International and Comparative Law*, v. 6, n. 640, 2002.

94 The CEN-CENELEC mandates EU member states to embed climate adaptation strategies in all future development activities within the EU. See https://www.cencenelec.eu/standards/Sectorsold/ClimateChange/Pages/default.aspx. AAKRE, Stine; RÜBBELKE, Dirk T. G. Adaptation to climate change in the European Union: efficiency versus equity considerations. *Environmental Policy and Governance*, v. 20, n. 3, p. 159-179, 2010.

95 The proposal is for a regulation that seek to include the removal of GHG Emissions from Land Use, Land Use Change and Forestry (LULUCF Regulation) into the 2030 Climate and Energy Framework. The proposal also seeks to amend Regulation (EU) No. 525/2013 on a Mechanism for Monitoring and Reporting GHG Emissions and Other Information Relevant to Climate Change, 20 July 2016, COM (2016) 479. This LULUCF Regulation proposal requires that, from 2021 emissions and removals must be balanced in land-use and forestry sectors, including agricultural land use for arable crops and grassland. See Article 4 LULUCF Regulation.

96 VON HOMEYER, Ingmar. The evolution of EU environmental governance. *In:* SCOTT, Joanne (ed.). *Environmental protection*: european law and governance. Oxford: Oxford University Press, 2009.

Agricultural Policy (CAP) and the European Network for Rural Development is yet another example of a regionally harmonized, flexible, and well-established governance framework, which advances CSA measures, especially crop diversification, through the "green direct payment" option among rural communities and national governments within the EU. [97] Through its "From Farm do Fork" policy, the CAP also advocate for "a healthier and more sustainable food system" in the EU. Consequently, climate change actions as provided by the EU present unique and relevant standards that could be beneficial for CSA practices especially in Kenya and Nigeria.

3.4 Transnational municipal networks

Due to their unique position as intermediary authorities between the local and national levels, municipalities are seen as harbingers for a climate-safe future, and as drivers of global sustainable development.[98] At the transnational level, a network of municipalities is designated as Transnational Municipal Networks (TMNs). TMNs are organizations that aim to support cooperation between cities to improve their climate change actions through the adoption of certain qualitative and quantitative climate goals, such as assessing the impact of policies and initiatives on a range of social, economic, and environmental dimensions.[99] TMNs have impacts across many major cities globally, and they represent an innovative model of multilevel governance initiatives in climate change actions.[100] Climate Alliance,[101] International Council for Local Environmental Initiatives (ICLEI),[102] Energie-Cities, [103] etc., are examples of TMNs.[104] Through TMNs, municipalities commit to developing local climate change action strategies or integrating climate change actions into plans already developed through the expansion of support for local activities.[105]

TMNs represent the most vibrant and dynamic examples of standards in climate change governance. Bulkeley *et al.*, identified some of these standards as norm setting, capacity building, information sharing and target setting.[106] For example, the ICLEI, through a subsidiary network known as Cities for Climate Protection (CCP), adopted a regulative strategy called benchmarking to set an emission reduction target, requesting an emissions inventory, formulating an action plan, and progress monitoring for CCP network members.[107] In the same manner, 'the Climate Alliance' (also a TMN) annually rewards municipalities with 'Climate Star' for their achievements in implementing climate change actions options according to expected standards.[108]

According to Papin, information sharing signifies the dissemination of information and knowledge regarding climate change actions to city members and other

97 PE'ER, Guy *et al.* A greener path for the EU Common Agricultural Policy. *Science*, v. 365, n. 6452, p. 449-451, 2019.

98 Cities became key actors in global climate governance, as transnational municipal networks (TMNs) after recognizing the role they at the COP 13 in Bali in addressing the impacts of climate change through both mitigation and adaptation for instance. RABE, Barry G. Beyond Kyoto: climate change policy in multilevel governance systems. *Governance*, v. 20, n. 3, p. 423-444, 2007. See http://old.iclei.org/index.php?id=1201. JOHNSON, Craig; TOLY, Noah; SCHROEDER, Heike (ed.). *The urban climate challenge*: rethinking the role of cities in the global climate regime. London: Routledge, 2015. ANDONOVA, Liliana B.; BETSILL, Michele M.; BULKELEY, Harriet. Transnational climate governance. *Global Environmental Politics*, v. 9, n. 2, p. 52-73, 2009. KERN, Kristine; BULKELEY, Harriet. Cities, Europeanization and multi-level governance: governing climate change through transnational municipal networks. *Journal of Common Market Studies*, v. 47, n. 2, p. 309-332, 2009.

99 TMNs also perform some functions such as hosting events, producing information, representing cities internationally, etc., as part of support to cities in order to improve their climate change mitigation and adaptation work. VAN DER HEIJDEN, Jeroen *et al.* Advancing the role of cities in climate governance–promise, limits, politics. *Journal of Environmental Planning and Management*, v. 62, n. 3, p. 365-373, 2019.

100 It is possible for a city to be a member of more than one TMN. Multiple membership means more support for cities and from different network, and more advanced adaptation planning process. OLECKI, William *et al.* City transformations in a 1.5 C warmer world. *Nature Climate Change*, v. 8, n. 3, p. 177-181, 2018.

101 See https://www.climatealliance.org/home.html.

102 See www.iclei.org.

103 See https://energy-cities.eu/.

104 These TMNs have member spread across cities in Europe and the United States, and their aim is to reduce emission of up to 50 percent CO2 emission below 1990 levels by 2030 and protect rainforest through partnerships and project with Indigenous rainforest peoples. PAPIN, Marielle. Transnational municipal networks: harbingers of innovation for global adaptation governance? *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 467-483, 2019.

105 See: https://urbact.eu/mayors-adapt-covenant-mayors-new-initiative-adaptation-climatechange.

106 BULKELEY, Harriet *et al.* Introducing transnational climate change governance. *In:* BULKELEY, Harriet *et al.* (ed.). *Transnational climate change governance*. Cambridge: Cambridge University Press, 2014. p. 1-16.

107 See http://southasia.iclei.org/our-activities/our-pathways/low-emission-development/cities-for-climate-protection-ccp-campaign.html.

108 See https://www.climatealliance.org/home.html.

stakeholders.[109] In other words, information disseminated through databases, newsletters and study tours has the benefits of: "[b]eing open and inclusive, as well as tend to avoid the need for explicit forms of intervention or the use of more hierarchical forms of authority within the network."[110]

It is noteworthy that the aforementioned standards for climate change actions provided by TMNs (norm setting, capacity building, and information sharing) are not hard rules but represent an alternative climate change action governance that is softer and more indirect in approach.[111] These soft rules simply involve voluntary compliance based on recognition of the authority of TMNs by network members or due to "peer pressure and competition." [112]

Hence, the relevance of TMNs to CSA is that of fostering agreement with and adopting progressive climate change laws and policies from national, intergovernmental, and transnational organizations.[113] These kinds of agreements led to the formation of collaborative networks such as the Global Climate Action Agenda (GCAA),[114] the Southern Voice,[115] the R4 Rural Resilience Initiative,[116] African adaptation initiative (Africa adapt),[117] the National Adaptation Program Global Network, [118] Cities Climate Leadership Group (C40),[119] ICLEI, and the Global Covenant of Mayors for Climate and Energy, [120] which have impacts across many major cities globally.[121]

3.5 Transnational corporations

After TMNs, transnational corporations (TNCs) also play vital roles in facilitating climate change actions as well as in promoting CSA.[122] TNCs operate at the state level and across state borders.[123] In governance

[109] PAPIN, Marielle. Transnational municipal networks: harbingers of innovation for global adaptation governance? *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 467-483, 2019.

[110] PAPIN, Marielle. Transnational municipal networks: harbingers of innovation for global adaptation governance? *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 467-483, 2019.

[111] DAVIDSON, Kathryn; GLEESON, Brendan. Interrogating urban climate leadership: toward a political ecology of the C40 network. *Global Environmental Politics, v.* 15, n. 4, p. 21-38, 2015.

[112] BULKELEY, H. *et al.* Governing climate change transnationally: assessing the evidence from a database of sixty initiatives. *Environment and Planning C*: Government and Policy, v. 30, n. 4, p. 591-612, 2012.

[113] HAPPAERTS, Sander; VAN DEN BRANDE, Karoline; BRUYNINCKX, Hans. Subnational governments in transnational networks for sustainable development. *International Environmental Agreements*: Politics, Law and Economics, v. 11, n. 4, p. 321-339, Nov. 2011. PLUIJM, R.; MELISSEN, J. Clingendael ciplomatic. Studies Papers, v. 10, p. 5-36, 2007.

[114] The GCAA is an umbrella body of actors such as NGOs, business, cities, academia and intergovernmental organizations (IGOs) who are responsible for promoting transnational adaptation initiatives. For example, the Marrakesh Partnership for Global Climate Action launched in 2016 is part of the GCAA. The Marrakesh Partnership is expected to catalyse action on climate change by all parties in order further increase ambition of emission reduction before 2020 and to support the Paris Agreement. See https://unfccc.int/climate-action.

[115] The Southern Voices is a coalition of climate networks and partners in the Global South. It serves as a benchmark tool for adaptation planning and implementation that has been put to practice in several countries. See https://careclimatechange.org/southern-voices/.

[116] The R4 Rural Resilience Initiative is led by the World Food Programme (WFP). R4 Rural Resilience Initiative is aimed at building behavioural change towards improved livelihoods in rural areas of LDCs, through the development of risk management strategies, such as insurance mechanisms. See https://www.wfp.org/publications/2017-r4-rural-resilience-initiative-quarterly-report-july-september-2017. VOGEL, David. Private global business regulation. *Annual Review Political Science*, v. 11, p. 261-282, 2008.

[117] See https://africaadaptationinitiative.org/.

[118] See http://napglobalnetwork.org/about/.

[119] The C40 was established in 2005, as a network of global megacities concentrating on climate action. Its target is to develop and implement policies and programmes that generate measurable reductions in both greenhouse gas emissions and climate risks. C40 represents a new phase of transnational urban governance, as it connects the most powerful and influential mayors of global megacities in adopting a more visible political stance on climate change governance. Available at: http://www.c40.org. DAVIDSON, Kathryn; GLEESON, Brendan. Interrogating urban climate leadership: toward a political ecology of the C40 network. *Global Environmental Politics, v.* 15, n. 4, p. 21-38, 2015.

[120] See https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0014&. The Global Convent of Mayors is a merger of two related transnational climate governance initiatives i.e., the Mayors Adapt and the Covenant of Mayors. Specifically, the Mayors Adapt has been acclaimed as an innovative model of multi-level (global) best practices towards adaptation, where in cities committed themselves to developing local adaptation strategies or integrating adaptation into plans already developed through the expansion of support for local activities. See https://urbact.eu/mayors-adapt-covenant-mayors-new-initiative-adaptation-climatechange.

[121] For a detailed explanation, see PAPIN, Marielle. Transnational municipal networks: harbingers of innovation for global adaptation governance? *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 467-483, 2019.

[122] BIAGINI, Bonizella; MILLER, Alan. Engaging the private sector in adaptation to climate change in developing countries: importance, status, and challenges. *Climate and Development*, v. 5, n. 3, p. 242-252, 2013.

[123] STRANGE, Roger *et al.* Corporate governance and international business. *Management International Review*, v. 49, p. 395-407,

matters, TNCs are partly the reason for the transformation of public governance options from the usual 'traditional voluntary governance arrangements' to 'modern coordinated governance arrangements'.[124] This transformational shift in governance arrangement could be attributed to the superior economic power and vast amount of topic knowledge that TNCs possess over their host governments.[125] Some TNCs such as Monsanto, Epson, Total, Shell, GlaxoSmithKline, Exon Mobil have interest in Africa and Asia and they possess vast amounts of resources equivalent to, or even more than the resources of smaller states of these continents.[126] Based on this revelation, TNCs are seen as having the ability to supply resources and/or the expertise needed for climate change actions.[127] For example, TNCs serve as a significant source of financing for climate change actions programs under the UNFCCC.[128]

In the same regards, TNCs influence vital policies, laws, regulations, in many respects include climate change actions and CSA. Simply because, being aware of their vulnerability to the impacts of climate change, TNCs (especially agriculture-based) implement measures in anticipation of or in response to climate change impacts.[129] For TNCs, embarking on climate change actions activities "is not only a story of risk management, but also of business opportunity."[130] TNCs use a variety of terminologies, such as resilience, business continuity, enterprise risk management, or flood risk management, to describe their responses to climate risks.[131] In the context of CSA, Starbucks,[132] for instance, provides training to coffee farmers in Indonesia on composting,[133] pruning,[134] and shading[135] techniques that help protect coffee plants from rising temperatures.[136] Levi's teaches rain-harvesting techniques to cotton farmers in Brazil, Pakistan, India, and West Africa so that they can conserve water in dry regions.[137] A chemical producing and marketing company, BASF produces drought-tolerant corn varieties, as a means of facilitating climate change actions.[138] Similarly, based on reputational[139] and

2009; See https://unctad.org/en/Pages/Home.aspx.

124 See for example, SORSA, Kaisa. Private-regulation in global value chain-a trade barrier or an opportunity for public-private cooperation. *In*: CONFERENCE OF THE EUROPEAN CONSORTIUM ON POLITICAL, 3., 2010, Dublin. *Proceedings [...]*. Dublin: University College Dublin, 2010; VICTOR, David G.; RAUSTIALA, Kal; SKOLNIKOFF, Eugene B. (ed.). *The implementation and effectiveness of international environmental commitments*: theory and practice. Cambridge: MIT Press, 1998.

125 SIMONS, Penelope. International law's invisible hand and the future of corporate accountability for violations of human rights. *Journal of Human Rights and the Environment*, v. 3, n. 1, p. 5-43, 2012.

126 MONTEIRO, Carlos A.; CANNON, Geoffrey. The impact of transnational "big food" companies on the South: a view from Brazil. *PLoS Medicine*, v. 9, n. 7, 2012.

127 Through corporate social responsibility initiatives, TNCs can serve as a significant source of financing for climate change mitigation and adaptation. BACKER, Larry Catá. Multinational corporations, transnational law: the United Nations' norms on the responsibilities of transnational corporations as a harbinger of corporate social responsibility in international law. *Columbia Human Rights Law Review*, n. 37, 2005. p. 287.

128 See http://unfccc.int.

129 BERKHOUT, Frans; HERTIN, Julia; ANN, David M. Learning to adapt organisational adaptation to climate change impacts. *Climatic Change*, v. 78, n. 1, p. 135-156, 2006.

130 See https://wdh01.azureedge.net/-/media/demant/main/media-documents/responsibility/carbon-disclosure-project-2014.pdf?la=en&rev=7799.

131 BACKER, Larry Catá. Multinational corporations, transnational law: the United Nations' norms on the responsibilities of transnational corporations as a harbinger of corporate social responsibility in international law. *Columbia Human Rights Law Review*, n. 37, 2005. p. 287.

132 Starbucks is an American coffee producing and supplying company founded in Seattle, Washington, in 1971. The company presently operates in over 30,000 locations worldwide. See https://www.starbucks.com/.

133 Composting is a process whereby the activities of microorganisms are used in converting microbial product and organic wastes into humus. See TOZE, S.; SIDHU, J. Biosolids: human health impacts. *In*: NRIAGU, J. O. *Encyclopedia of Environmental Health*. Amesterdã: Elsevier Science, 2011. p. 394-402.

134 Pruning means removing all dead and small branches that grow at the bottom of tree trunk, except the thickest and best branches. See http://www.fao.org/3/AD219E/AD219E06.htm.

135 Shading is a process where coffee is grown under tree shades in order to filter CO2 and minimize erosion. Due to soil moisture retention, shade-grown coffee requires little or no chemical fertilizers, pesticides, or herbicides. See https://learn.eartheasy.com/guides/shade-grown-coffee/.

136 See https://www.wri.org/blog/2013/11/3-ways-multinational-corporations-can-help-vulnerable-communities-adapt-climate-change.

137 AVERCHENKOVA, Alina *et al.* Multinational and large national corporations and climate adaptation: are we asking the right questions?: a review of current knowledge and a new research perspective. *Wiley Interdisciplinary Reviews*: Climate Change, v. 7, n. 4, p. 517-536, 2016. See also https://www.wri.org/blog/2013/11/3-ways-multinational-corporations-can-help-vulnerable-communities-adapt-climate-change.

138 MCFADDEN, Jonathan *et al.* Development, adoption, and management of drought-tolerant corn in the United States. *Economic Information Bulletin*, n. 204, Jan. 2019.

139 However, some business analyst maintained that reputations alone do not stimulate companies to carry out strategic adaptation plans. Even where companies declare adaptation as part of their corporate social responsibility that is merely superficial and cosmetic remark. For example, see PULVER, Simone; BENNEY, Tabitha. Private-sector responses to climate change in the Global South. *Wiley Interdisciplinary Reviews*: Climate Change, v. 4, n. 6, p. 479-496, 2013.

stakeholder/investor pressures,[140] TNCs are compelled to facilitate climate change actions (including CSA as the case may be), because it will minimize the potential impacts of climate change on their supply chains, improve their resource efficiency, as well as enhance their production and use of sustainable raw materials, etc. [141]

3.6 Non-governmental organisations

Non-governmental organisations are "formed by individuals or private groups with common objectives."[142] These objectives could be the protection of political, social, and economic interests, or even the protection of the environment. Examples of NGOs that are vested with an interest in environmental protection include the International Union for Conservation of Nature (IUCN),[143] Friends of the Earth,[144] Greenpeace International, and Worldwide Fund for Nature (WWF). These NGOs play an important role in the development of, and compliance with, international environmental norms and standards, including climate change actions and CSA.[145] NGOs have contributed to the elaboration of the transnational climate change action governance regime by participating in the drafting of international agreements[146] and by influencing and promoting environmental policies at the international, regional, and national levels through positive decisions.[147] Statistics have revealed that NGOs are the most commonly engaged actors in climate change action governance, for at least one NGO is involved as a partner in about 85% of climate change action initiatives globally.[148]

Therefore, the effectiveness of the climate change action is enhanced by NGOs when they bring in resources and knowledge that state actors do not possess.[149] For example, NGOs draft or develop norms for either their own governance or submission to states for adoption.[150] Thus, engaging NGOs in climate change action processes has been noted to leverage government efforts and to stimulate civil society and community efforts in the mobilization of financial resources and the provision of technical capacity with respect to climate change action technologies and innovative services.[151] Again, the involvement of NGOs in national and international climate change action efforts could facilitate the flow of information[152] related to climate change action efforts in the private sector.[153] For example, NGOs played vital roles in the success of projects and programs financed by the Least Developed Countries Fund (LDCF)[154] and the Special Climate Change Fund (SCCF),[155] both established by the Conference of Parties (COP) of the UNFCCC 2001.[156]

140 Sometimes stakeholders in the corporate world such as insurers, banks, investors, regulators, civil society organisations, governments and customers, mount pressure on companies to address climate risks. See MEG, Crawford; SEIDEL, Stephen. *Weathering the storm*: building business resilience to climate change. Virginia: Center for Climate and Energy Solutions, 2013.

141 CHU, Eric K. Transnational support for urban climate adaptation: emerging forms of agency and dependency. *Global Environmental Politics*, v. 18, n. 3, p. 25-46, 2018.

142 DAMROSCH, Lori Fisler. The legitimacy of economic sanctions as countermeasures for wrongful acts. *Berkeley Journal of International Law*, v. 37, n. 249, 2019.

143 See https://www.iucn.org/.

144 See https://www.foei.org/.

145 KISS, Alexandre; SHELTON, Dinah. *Guide to international environmental law*. Leiden: Brill, 2007.

146 For example, NGOs were present, as observer during the drafting of the Kyoto Protocol and other international environmental treaty negotiations. KISS, Alexandre; SHELTON, Dinah. *Guide to international environmental law*. Leiden: Brill, 2007.

147 KISS, Alexandre; SHELTON, Dinah. *Guide to international environmental law*. Leiden: Brill, 2007.

148 DZEBO, Adis. Effective governance of transnational adaptation initiatives. *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 447-466, 2019.

149 CHAN, Sander; AMLING, Wanja. Does orchestration in the Global Climate Action Agenda effectively prioritize and mobilize transnational climate adaptation action? *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 429-446, 2019.

150 KISS, Alexandre; SHELTON, Dinah. *Guide to international environmental law*. Leiden: Brill, 2007.

151 MILLER, Alan. Engaging the private sector in adaptation to climate change in developing countries: importance, status, and challenges. *Climate and Development*, v. 5, n. 3, p. 242-252, 2013.

152 The compliance procedures for MEAs are most often informational. Reporting must be distinguished from mere exchange of information or occasional communication of factual or scientific information not necessarily related to the implementation of environmental agreements. DZEBO, Adis. Effective governance of transnational adaptation initiatives. *International Environmental Agreements*: Politics, Law and Economics, v. 19, p. 447-466, 2019.

153 DAVIES, Julia. Barriers and enablers to climate change adaptation in north-central Namibia. *Adaptation at Scale in Semi-Arid Regions*, p. 1-8, Sept. 2017; JOBBINS, Guy *et al. Resilience, equity and growth in semi-arid economies*: a research agenda. London: Prise, 2016.

154 See https://www.thegef.org/what-we-do/topics/least-developed-countries-fund-ldcf.

155 See https://www.thegef.org/what-we-do/topics/special-climate-change-fund-sccf.

156 See COP Decision 3/CP.17, FCCC/CP/2011/9/Add.1, 55; VERSCHUUREN, Jonathan (ed.). *Research handbook on climate change adaptation law*. London: Edward Elgar Publishing, 2022. BIAGINI, Bonizella; MILLER, Alan. Engaging the private sector in adaptation to climate change in developing countries: importance, status, and challenges. *Climate and Development*, v. 5, n. 3, p. 242-252, 2013.

The relevance of NGOs in facilitating CSA actions is for instance, noticeable by the activities of the Sustainable Agriculture Network (SAN) in its effort to conserve biodiversity and promote rural development.[157] The Climate Action Network is yet another NGO based in Canada and the United States that provides strategic advice, technical assistance, and finances for climate change action projects, including CSA.[158]

Despite the aforementioned needs and benefits of engaging NGOs in climate change action processes, NGOs should not be deemed as an alternative or a substitute for state actor entities, especially national governments. Rather, it should be noted that NGOs rely on state actors for support in gathering information, enabling policies and regulations, etc.[159]

4 The impact of transnational standards on CSA

Transnational standards present new opportunities for CSA given the convergence of collective actions taken by international, regional, and national governing entities. As far as CSA is concerned, this form of collective actions can leverage flexible and effective yet coordinated governance modalities both at national and local levels. In addition, transnational standards serve as the fulcrum for private and civil society organisation to perform specific roles in shaping the operationalisation of CSA practices in given circumstances. For connected purposes, transnational standards would facilitate effective enforcement of CSA policies and regulations at the regional and national levels. As well, risk management for CSA practices would be seemingly transparent. In the same context, the application of transnational standards to CSA practices could promote coordinated and required support for food security at the global level, in terms of capacity building, technology transfer and financing.

Most importantly, Abbott is of the opinion that a transnational regime could mount pressure or "motivate recalcitrant states that lack initiatives for CSA to adopt standards backed by multiple actors at different levels and scales of authority."[160] For example, a transnational regime could facilitate CSA by influencing governments to establish agricultural research institutions,[161] consisting of representatives from key groups (especially government, industry, communities, indigenous peoples, academics, professionals, and non-profit organizations), to collaborate on the formulation and implementation of strategies and measures.[162] Having agricultural research institutions with multiple representatives and sources of expertise would also promote all-inclusive and coordinated CSA laws and policies at national and regional levels.[163] For connected purposes, it is also believed that a transnational regime presents an opportunity for the provisions of intergovernmental organizations (such as those of the UNFCCC) on CSA to be implemented by local authorities.[164]

In the same context, transnational standards can complement or improve existing indigenous knowledge systems (IKS) for CSA methods in African and developing countries. Given that climate change actions especially adaptation are mostly implemented by local institutions, an integration of transnational standards could bring in array of innovative ideas by institutions that "can enhance the employment and scaling success of climate adaptation projects and innovations."[165] Already, the role of IKS in promoting climate change actions including CSA, as well as in complementing scientific

[157] SAN works with the Rainforest Alliance in order to reach a broad set of target communities in over 42 countries covering about 1.2 million farms that span over 3.5 million hectares. See https://www.rainforest-alliance.org/business/certification/.

[158] See https://climateactionnetwork.ca/about-can-rac/.

[159] GANNON, Kate; CRICK, Florence. Enabling private sector adaptation to climate change in sub-Saharan Africa. *Wiley Interdisciplinary Reviews*: Climate Change, v. 9, n. 2, 2018.

[160] ABBOTT, Kenneth W. Strengthening the transnational regime complex for climate change. *Transnational Environmental Law*, v. 3, n. 1, p. 57-88, 2014.

[161] Research institutions are saddled with the task of rendering Indigenous values into scientific values. See AGRAWAL, A. Local institutions and adaptation to climate change. *In:* MEARNS, Robin; NORTON, Andrew (ed.). *Social dimensions of climate change*: equity and vulnerability in a warming world. Washington: The World Bank, 2010. p. 173-178.

[162] See https://www.nrcan.gc.ca/climate-change/impacts-adaptations/what-adaptation/adapting-our-changing-climate/10027.

[163] ABBOTT, Kenneth. The transnational regime complex for climate change. *Environment and Planning C*: Government and Policy, v. 30, n. 4, p. 571-590, 2012.

[164] KIM, Yoon *et al.* A perspective on climate-resilient development and national adaptation planning based on USAID's experience. *Climate and Development*, v. 9, n. 2, p. 141-151, 2017.

[165] MUTAMBISI, T. *et al.* Climate change adaptation in Southern Africa: universalistic science or indigenous knowledge or hybrid. *In:* LEAL FILHO, Walter *et al* (ed.). *African Handbook of Climate Change Adaptation*. Frankfurt: Springer, 2020. p. 1-16.

knowledge has been recognized and affirmed by some actors responsible for promoting transnational standards. It has been argued that IKS when combined with transnational standards could remedy "blind spots" created modern scientific methods for climate change actions.[166] Put differently, indigenous communities are experts in warning signs for recurrent climate change risk and vulnerabilities, and are acquainted with indigenous mitigation and adaptation measures.[167] Apart from ecological factors, climate change actions under IKS are also guided by socioeconomic motivations. Thus, transnational standards for CSA could benefit from a range of advice from IKS stakeholders and policy makers, and this can for instance, promote an effective CSA policies and decisions that are participatory, cost-effective and even sustainable.[168] What this means that there will be a viable implementation of transnational standards in poor countries, including more solid foundation on relative impacts of climate change on agricultural activities.

5 Conclusion

In addition to satisfying food and feed needs, agriculture is a source of employment, revenue, and GDP in many countries. Despite the importance of agriculture, certain practices associated with agriculture, such as crop and livestock production methods, are partly responsible for GHG emissions and ultimately climate change. The concept of CSA has been identified as options for addressing the impacts of climate change on agriculture. As a strategy, CSA has a dual role to play. First the strategy helps in protecting the environment against agriculture-induced climate change. Second, CSA methods are employed in addressing the impacts of climate change on agriculture. In other words, CSA has the potentials of supporting agricultural production, and in promoting adaptation and mitigation actions in the context of agriculture through the adoption of carbon-neutral technologies and other efficient and sustainable farming strategies.

Considering that the impacts of climate change are global but mostly felt at the local level, it is essential to support CSA actions with law and a mixture of non-law standards provided by different actors. These actors represent collective mutual interests (public goods) and individual competing interests (business advancement) relative to climate change governance, which are systematically addressed in international forums. In addition, these actors were guided by formal and informal processes, rules, and compliance procedures aimed at addressing the impacts of climate change. This arrangement, which is referred to as transnational standards regime, portrays interconnected and rapidly evolving ideas that manifest itself regionally (such as in the structures of the EU), and internationally as it occurs in supra-natural structures such as in UNFCCC, as well as municipally, as expressed by the coordinated actions of Climate Alliance and ICLEI's Cities for Climate Protection (CCP) in adapting to drought and desertification. It is proposed and envisaged that the standards provided by the transnational standard regime are capable of adequately promoting CSA actions in developing countries such as Kenya and Nigeria.

[166] LUDWIG, P. *et al*. Impacts of surface boundary conditions on regional climate model simulations of European climate during the Last Glacial Maximum. *Geophysical Research Letters*, v. 44, n. 10, p. 5086-5095, 2017.

[167] HIWASAKI, L.; LUNA, E.; SHAW, R. Process for integrating local and indigenous knowledge with science for hydro-meteorological disaster risk reduction and climate change adaptation in coastal and small island communities. *International Journal of Disaster Risk Reductio*n, v. 10, p. 15-27, 2014.

[168] HUNN E. What is traditional ecological knowledge? *In*: WILLIAMS N.; BAINES, G. (ed.). *Traditional ecological knowledge*: wisdom for sustainable development. Canberra: Centre for Resource and Environmental Studies, 1993. p. 3–15. See also ROBINSON J.; HERBERT D. Integrating climate change and sustainable development. *Int J Glob Environ Issues*, v. 1, n. 2, p. 130–148, 2001.

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