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Climate Change and Sustainable Practices: Telehealth as a Tool for Sharing Indigenous Practices

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***Abstract*—** *The use of telehealth is growing as an auxiliary tool for urbanized societies in the propagation of teaching and health care for Indigenous communities. However, little has been discussed regarding the potential applicability as an instrument for the propagation of Indigenous cultural traditions that positively impact the health and well-being of their communities, whose organizational habits influence the containment of climate change, or be it, conditions that favor the global health of the planet. The methodology that was used to choose which practices would be analyzed was based on the systematization carried out in 2019 by the United Nations. Articles published in the last five years were selected in order to ensure that the discussion would be guided by contemporary perspectives. We sought to enumerate some of the consequences that climate change may have for different social groups over the coming few decades and to report the agricultural practices of Brazilian Indigenous peoples, who apply sustainable methodologies in their daily lives, with habits that have been passed down from generation to generation. These practices could be propagated to urbanized industrial communities by means of the multiplication of an original telehealth program created and transmitted by Indigenous peoples, based on their millenary knowledge about sustainable community health.*

I. INTRODUCTION

The use of telehealth is growing as an auxiliary tool for urbanized societies in the propagation of teaching and health care for Indigenous communities. However, little has been discussed regarding the potential applicability as an instrument for the propagation of Indigenous cultural traditions that positively impact the health and well-being of their communities, whose organizational habits influence the containment of climate change, or be it, conditions that favor the global health of the planet.

The processes of climate change, mainly during the Pleistocene era, have regulated the distribution of species across the planet (1,2). Accordingly, these processes may have natural causes; however, they are also influenced by human activities. Since the industrial revolution, humans have begun to emit large amounts of greenhouse gases, especially carbon dioxide. Therefore, human activities began to have a major impact on climate change (3). The Intergovernmental Panel on Climate Change of the United Nations agency responsible for providing scientific information has stated that the increase in Earth's temperature is certainly caused and exacerbated by human activities (4).

Brazil is one of the countries that most contribute to the worsening of this unprecedented environmental crisis. According to data from the World Wide Fund for Nature (3), land use and deforestation patterns are the main causes

of greenhouse gas emissions in Brazil. In the year 2020 alone, 1,385,300 hectares of green areas were deforested in Brazil (5). As a result, droughts, floods, hurricanes, severe storms, heat waves, forest fires, periods of intense cold, and landslides will become increasingly common, with not only local effects, but also catastrophic events across the planet (6). These factors tend to impact diverse populations, both by damaging food and consumer goods production chains and by creating more vulnerable groups of people, due either to social risks or to the fact that they end up becoming more susceptible to natural disasters. Furthermore, it is important to emphasize the significant impact on the planet's biodiversity, where an imbalance creates a cascading effect, which has repercussions on human health as well.

With this in mind, we will seek to enumerate some of the consequences that climate change may have for different social groups over the coming few decades. We will also seek to report the agricultural practices of Brazilian Indigenous peoples, as they apply sustainable methodologies in their daily lives, with habits that have been passed down from generation to generation in a chain of educational knowledge related to the values of their traditions. These practices could be propagated to urbanized industrial communities by means of the multiplication of an original telehealth program created and transmitted by Indigenous peoples, based on their millenary knowledge about sustainable community health.

II. METHODOLOGY

Throughout this article, we will present the diverse sustainable practices developed by Indigenous peoples in Brazil, shedding light on the manner in which they contribute to mitigating the circumstances of climate change and, moreover, how these practices are useful tools to prevent catastrophic scenarios.

The methodology that was used to choose which practices would be analyzed is based on the systematization carried out in 2019 by the United Nations (7), according to indices showing that 28% of land areas are managed by Indigenous populations. In comparison with other territories, these are the places where biodiversity shows the highest rates of preservation. Accordingly, the United Nations has systematized a series of Indigenous practices that contribute to sustainable development.

Articles published in the last five years were selected in order to ensure that the discussion would be guided by contemporary perspectives, with an updated view of the environmental circumstances in which we are inserted.

As exceptions, the following two older scientific articles were included, due to the relevance of citations in other selected articles: "Rediscovery of Traditional Ecological Knowledge as Adaptive Management" (8) by Fikret Berkes and Johan Colding, published in 2000 and "Estimating greenhouse gas emissions from future Amazonian hydroelectric reservoirs" (9) by Felipe de Faria, published in 2015.

Thus, a qualitative study was developed on this topic and updated according to the most recent climate and environmental changes that have been observed.

With the objective of transmitting Indigenous agricultural practices as a strategy to mitigate the climate changes that are already underway, the use of telehealth technology is subsequently suggested as a tool for sharing millenary knowledge of traditional peoples and transmitting (teaching) this knowledge to contemporary urban societies. This would multiply their sustainable practices, such as cultural habits that also affect human health.

First, agricultural practices will be analyzed, followed by forest restoration strategies, traditional food habits, and, finally, environmental surveillance practices.

III. DEVELOPMENT

As previously mentioned, the impacts of climate change will affect diverse groups, even those whose practices are considered sustainable. In the case of Indigenous populations, they are affected in different ways. From land delimitation, which is impacted by the encroachment of agribusiness, to the rupture of traditional practices that guarantee a harmonious and sustainable lifestyle. Therefore, we seek here to present a series of sustainable practices developed by Indigenous peoples and to describe how they contribute to mitigating the climate change scenario or serve as an example in order to avoid this type of scenario.

3.1. Indigenous Peoples and Lands

The last census conducted in Brazil, in 2010, indicated an Indigenous population composed of 896,900 people distributed in different ethnicities. The survey was suspended due to lack of funding from the federal government; however, it is estimated that there are currently around 1.3 million Indigenous people in Brazil (10). From the moment that there is no knowledge about how Indigenous peoples are distributed throughout the country, in addition to a lack of estimates regarding their social demands, it becomes unfeasible to implement public policies of sociodemographic protection.

Indigenous peoples' knowledge and their permanence on their lands are essential to the preservation of their traditions and the environment. It is estimated that, in Brazilian

Indigenous lands, about 25% of the carbon stock is retained in the form of forests (11). The act of depriving Indigenous peoples of these lands, whether by the so-called *Marco Temporal* ("time frame" argument) or by illegal land grabbing (known as *grilagem* in Portuguese), causes deforestation to encroach on previously preserved forests, thus returning carbon to the atmosphere through greenhouse gas emissions. The delimitation of lands, which determines the physical limits of lands that belong to Indigenous peoples, aims to protect them from possible invasions and occupations by people who are not Indigenous. Ensuring the protection of these borders is also a means of protecting the identities, lifestyles, traditions, and cultures of these peoples (12).

3.2. Sustainable Practices

Based on the promulgation of the Brazilian Constitution of 1988, Indigenous peoples have the right to their traditionally occupied lands. The right to land and the protection of their traditions are important due to all the historical aspects of Brazil experienced by Indigenous peoples, aspects that are marked by physical and cultural devastation that exterminated diverse ethnic groups, mainly due to the rupture between Indigenous peoples and their land (12,13). It is estimated that 28% of the earth's surface is managed by Indigenous peoples, and these areas concentrate the places where biodiversity is most preserved (7). Accordingly, Indigenous practices indicated by the United Nations that contribute to sustainable development are demonstrated in these locations.

3.2.1. Agricultural Practices

The knowledge of traditional peoples constitutes a cumulative framework of abilities, practices, and beliefs that evolves through processes of adaptation, and this knowledge is passed from generation to generation through the cultural transmission of the relationship between living beings and the environments where communities are located (8). Traditionally, Indigenous agriculture is subsistence agriculture, because it is based on a production-consumption model, prioritizing the satisfaction and needs of the Indigenous community (13).

Agricultural practices developed by Indigenous peoples are not only considered management techniques, but also part of their lifestyle, traditions, spirituality, and religious beliefs (14). For example, the Mbyá people, from the Yryapu Indigenous lands, in the municipality of Palmares, Rio Grande do Sul, grow a wide variety of foods, such as cassava, beans, corn, watermelon, and others (14). The fact that several associated cultures coexist prevents soil depletion. Furthermore, Norder et al (14) have indicated that the preservation of forests has been identified as essential for the cultural, social, and religious traditions of Indigenous peoples, and low-impact techniques demonstrate the extent to which soil is essential for food production. Therefore, these practices make the relationship between agriculture and the environment harmonious in Indigenous society.

3.2.2. Forest Restoration

Taking care of forests is not only achieved as a result of sustainable practices. Indigenous cultures refer to a connection of being with nature, where people and forests are part of the same environment, with adaptations of lifestyles in order to adjust and respect the environment. These are millenary practices that help to manage and "create forests". In this sense, an example has been found in the Amazon rainforest.

Increasing evidence has shown that the composition and structure of the modern flora of the Amazon rainforest were affected by pre-Columbian human activities (15). Humans have transformed forests in diverse manners, including planting plants (before felling and burning), spreading and propagating seeds, and growing useful resources, such as domesticated plants, in situ (16). The domestication of plant populations is the result of humans' ability to overcome environmental selection pressures and to create landscapes to manage and cultivate useful species, resulting in fundamental changes in ecosystems on a local and global scale (15). In this process, humans intentionally select plants which have characteristics that interest them, such as pleasant taste, larger fruits, and attractive smell; consequently, this makes specimens with these characteristics become more successful in relation to those that do not have such striking characteristics. As a result, human beings end up cultivating these specimens, which leads to the genotypes of these phenotypes being more frequently propagated. In this manner, in the Amazon rainforest, a study indicated that the surroundings of many archaeological sites were surrounded by greater abundance and richness of biodiversity (17). Therefore, the peoples who lived there were responsible for the cultivation of many plant species, demystifying the idea of a "virgin" forest. This indicates the historical role of Indigenous peoples, who were directly responsible for the construction of forests.

3.2.3. Food Traditions

According to a 2019 United Nations report (7), human populations basically use the following five crops as sources of energy: rice, wheat, corn, millet, and sorghum. This dependence on few plant options indicates that plantations have significantly advanced over forests. The Indigenous food system, on the other hand, has greater food diversity, which can help expand the repertoire of food sources for other non-Indigenous populations.

Food practices that are considered sustainable include the consumption of insects, which are also used as therapeutic resources; for example, beetle larvae are consumed cooked, fried, roasted, and raw by Guarani Indigenous people (18). There is already a discussion regarding consumption of insects as an alternative to animal feed and as a source of protein for humans, given that there is a limited amount of agricultural land, as well as an urgent need to find alternatives to conventional meat products (19,20).

It is also worth highlighting that, with respect to the practice of gathering as well, where Indigenous people seek food within their environment, whether by hunting and fishing or by gathering fruits and insects, they produce much of their own food, as mentioned in the "Agricultural Practices" chapter. This reflects the ways in which Indigenous peoples construct their food practices and are wholly dependent on the land.

3.2.4. Environmental Surveillance

As previously mentioned, in Brazil, approximately 25% of forests are considered Indigenous lands, and, in a global scenario, this number rises to 28% (7,11). One of the main reasons for disputes over lands belonging to Indigenous peoples is the encroachment of agribusiness into these lands. This entails the clearing of forests for the implementation of monocultures or pastures. These invasions frequently occur in the form of forest fires. Thus, the carbon contained in the trees returns to the atmosphere in the form of gases that are toxic to the environment. Nonetheless, this is not the only environmental problem related to the loss of Indigenous lands.

Monocultures are characterized by the extensive use of pesticides; as a consequence, these products are found on a large scale in aquatic environments (21). These pesticides are often detected not only in the environment; they also affect sediments and biological indicators, such as amphibians and fish (22). Thus, in addition to the exacerbated use of water during cultivation, chemical pollution of the environment, the emission of harmful gases during deforestation, and the use of machinery, there is also damage caused to the fauna. Many of these animals serve as food sources for Indigenous peoples and other tradition populations, and they are also environmental regulators, as is the case of bees.

It is not only agribusiness that affects Indigenous lands. There is still great pressure due to the encroachment of mining into these areas, and also, in some cases, flooding for the construction of hydroelectric plants. It is estimated that the area used for mining in the Amazon Region increased sixfold between 1985 and 2020, and expansion of illegal mining coincides with the invasion of Indigenous territories and conservation areas (5,23). In the case of hydroelectric plants, which are delivered with the promise of "clean energy", during the flooding and implementation of the dam, the dam emits methane gas due to the accumulation of decomposing organic matter (9). This occurs because the vegetation of the flooded area must be removed, but the decomposition of organic matter left by the cutting of trees and the carbon present in the soil will lead to the formation of carbon dioxide and methane (9).

3.3. Telehealth as a tool for sharing sustainable Indigenous practices

Telehealth has been used as a tool for screening diverse diseases in Indigenous communities, reducing the need to travel to tertiary units in urban centers and facilitating access to medical care in the Brazilian Unified Health System (24).

Nonetheless, in a broader view, the World Health Organization, in 1946, defined health as a state of complete physical, mental, and social well-being, rather than merely the absence of disease. Thus, the environment and sustainable human practices of interaction with the environment in addition to consequent climate changes are also important elements of health promotion in communities.

Accordingly, in addition to highlighting the numerous works related to the applicability of telemedicine as a unidirectional form of teaching and health care in Indigenous communities on the part of traditional academic medicine (25–52), we could also use telehealth as a tool for multiplying the knowledge of Indigenous peoples to urban communities, strengthening multidirectional communication related to agricultural practices, followed by forest restoration strategies, traditional food habits, and, finally, the practice of environmental surveillance, with the goals of constructing a more sustainable global society, mitigating climate change, and promoting health in a much broader biopsychosocial perspective.

IV. CONCLUSION

The presence of Indigenous peoples in their territories is already a milestone in combating climate change, given that this prevents the degradation of the habitat. The maintenance of their crops guarantees agroecological cultivation and consumption of healthier foods. Indigenous peoples' ways of life and their means of subsistence can teach the rest of the world a great deal about how to preserve natural resources. These millenary forms of knowledge can be shared through the use of telehealth communication tools, promoting health in a broader manner, including how to grow food sustainably and also how to live in harmony with nature.

Large-scale deforestation and flooding cause serious ecological imbalances, which affect the availability of hunting and fishing and reduce the area of arable land, with an increase in the population of vectors, including arthropods and mollusks, which ultimately leads to the incidence of malaria and other diseases (53). Despite the "greater good" premise of such projects, it is necessary to question the long-term effects of these forms of work. For instance, despite the immediate benefits of a mining enterprise, it will cause serious environmental damage throughout the years, with the destruction of green areas, breaking of biogeochemical cycles, and numerous other problems.

The same applies to the encroachment of agribusiness. Despite the arguments of food production necessary at a large scale, or, in other words, "Brazil, breadbasket of the world", it is increasingly important to consider how these activities will be carried out over the years. Monocultures deplete the soil and consume a large amount of nutrients in a short time, making it necessary to use chemical fertilizers. There is also an increase in pests as a result of the lack of biodiversity, and this is consequently linked to an increase in pesticide use. Moreover, climate change scenarios completely alter patterns of rainfall and seasons; therefore, the agribusiness sector is also negatively affected.

Therefore, public policies aimed at maintaining and protecting Indigenous lands are indispensable, including inspection and enforcement in relation to demarcations and return of the demographic census to verify demands. Finally, respect for Indigenous practices is important, and it would be ideal to propagate these practices via multidirectional communication and transmission of knowledge by means of telehealth tools. This would make it possible to encourage greater respect for the land and the environment in populations with a wider, aggregating, and proactive view of an original telehealth program created and transmitted by Indigenous peoples to other communities worldwide.

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