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Adaptation, mitigation and climate resilience: The Sustainable Development Goals 13 (SDG 13) and efforts to combat climate change in different parts of the world

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ABSTRACT

The Agenda 2030, published in September 2015, aims to promote actions related to the field of sustainable development. It is an action plan that aims to promote prosperity for people and the planet in several areas. The agenda has seventeen global objectives and 169 targets, among which is SDG 13 which deals with the climate issue. In this article we will present principles and strategies for climate mitigation, adaptation and resilience in different countries. There are countless green technologies developed in different countries with the aim of mitigating the effects of global warming and adapting societies to climate change. Strategies are being developed based on different knowledge, through breaking paradigms, through the appreciation of popular cultures and connections with science, based on partnerships between the State, market and the expansion of democratic spaces. To fulfill the objective, we carried out exploratory research, with a collection technique using primary and secondary sources on the subject.

Keywords: Agenda 2030, ODS 13, Climate adaptation, Mitigation, Global warming.

INTRODUCTION

The 2030 Agenda for Sustainable Development was adopted by all 193 United Nations Member States on September 25, 2015. The agenda is "a comprehensive plan of action for people, planet and prosperity" (UN, 2015). It is made up of 17 Sustainable Development Goals (SDGs) or Global Goals. Among which is SDG 13 which deals with climate actions:

> Objective 13. Take urgent measures to combat climate change and its impacts;
> 13.1 strengthen resilience and adaptive capacity to climate-related risks and natural disasters in all countries;
> 13.2 integrate climate change measures into national policies, strategies and planning;
> 13.3 improve education, increase awareness and human and institutional capacity on global climate mitigation, adaptation, impact reduction, and early warning of climate change;
> 13. to implement the commitment made by developed countries parties to the United Nations Framework Convention on Climate Change to the goal of jointly mobilizing US$100 billion per year by 2020, from all sources, to meet the needs of developing countries, in the context of significant mitigation actions and transparency in implementation; and fully operationalize the Green Climate Fund, through its capitalization, as soon as possible;
> 13.b promote mechanisms for building capacities for climate change-related planning and effective management in least developed countries, including with a focus on women, youth, local and marginalized communities (United Nations, 2015).

The SDG 13 is of paramount importance for the global context and is directly related to SDG

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4 (quality education), SDG6 (water management), SDG 11 (resilient and sustainable cities), SDG 12 (sustainable consumption patterns) and SDG 16 (promotion of peaceful and inclusive societies) (Ipea, 2018) and this connection is based on mitigation, adaptation and climate resilience actions, actions that are the pillars of SDG 13 in terms of strategies to combat climate change.

There are countless mitigation, adaptation and climate resilience actions carried out around the planet; strategies attempt to combat the causes and effects of global warming. These are efforts that require political mobilizations from different communities, which link research activities financed by governments with investments from the private sector and, above all, the articulations around combating climate change combine local knowledge and territory (Santos and Silveira, 2001) and preservation of local heritage with scientific innovations.

We are currently experiencing a process of transition and transformation that is producing a series of technological innovations to contain the effects and causes of global warming based on the union of ancestral knowledge, the riches of nature and science. Therefore, based on the importance of SDG 13, the objective of this text is to present some strategies for climate mitigation, adaptation and resilience. Specifically, we are going to verify whether the guiding principles are in place to build resilient societies and find out some technologies developed to combat climate changes in different places on the planet Earth.

The efforts we will highlight here contribute to achieving the objectives of the 2030 Agenda and other global agendas: the Paris Agreement and the Sendai Framework for Disaster Risk Reduction 2015-2030. Furthermore, we chose to present such initiatives because they can serve as useful examples for future initiatives in Brazil. The intention is not to state that it is possible to "transport" international experiences of adaptation, resilience and mitigation to the country, the objective is to provoke the following question: What paths were outlined so that such actions to combat climate change were created?

We will verify that the strategies, technologies and innovations that will be presented are the result of synergies, development in research, the need to maintain ways of life, economic interests and environmental awareness. Is it possible to reproduce these synergies in Brazilian territories? We believe so. Based on the Brazilian reality; from the strengthening of the university and research activities in Brazil; through the expansion of democratic mechanisms; expanding participation and deliberation to discuss environmental issues and decide which strategies are most appropriate for local communities and based on well-defined government guidelines.

Great advances are being made, at the 2023 United Nations Conference on Climate Change (COP28), Brazil launched the Ecological Transformation Plan, a proposal from the global south to promote sustainable development and rethink the inequalities of globalization (including Brazil will

host COP30 in 2025, the event will be in Belém). Just as, in 2024, the Ministry of the Environment transferred R$10 billion to the National Bank for Economic and Social Development – BNDES, the operator of the Climate Fund. This is the largest amount from the Climate Fund since it was created in 2009. According to Minister Marina Silva, it is the largest fund to combat climate change among developing countries.

Therefore, this discussion is also a small effort to contribute to the actions that have already been launched and are being developed in and by Brazil, we will contribute by presenting a kind of "list" with concepts, principles, action plans, strategies, technologies and knowledge in the field of climate mitigation, adaptation and resilience in different countries.

METHODOLOGY

To carry out the debate, we opted for an interdisciplinary approach, based on the concepts of mitigation, adaptation and climate resilience highlighted in SDG 13 and the three aforementioned global agendas, we chose to carry out exploratory research, as the objective of this type of research is to provide insight general information about a given object and expand knowledge about it, enabling a more precise formulation of the problem, which allows us to advance to new hypotheses and carry out more structured future research (Gil, 1999).

In this research, the scope is to provide another perspective on strategies to combat climate change, presenting some aspects of the debate, in order to prepare a theoretical environment for future in-depth studies on the topic. We also used qualitative description to capture the appearance of the phenomenon, but above all, to present its origins, networks and changes.

Regarding the data collection technique, we carried out bibliographical research, using primary and secondary sources. In relation to the first, we used the official documents of the global agendas that we mentioned and others derived from them; secondary sources come from books and articles, press news, we specifically searched websites and made use of documentaries accessible on video sharing platforms.

RESULTS AND DISCUSSION

ADAPTATION, RESILIENCE AND CLIMATE MIGRATION: EXAMPLES FROM AROUND THE WORLD

Adaptation and resilience: inseparable in combating climate change

They are generally local and/or regional actions, adapted to territorial realities (EPA, 2014; UN, 2015; EC, 2021). These are examples; 1) infrastructure for flood defenses, such as walls, barriers

or raising levels[2]; 2) "sponge cities", made up of green spaces (gardens, parks, grassy areas, etc.) combined with meteorological control centers and environmental awareness plans and training for the population to behave in the event of environmental accidents[3]; 3) artificial islands, which create a way of life linked to respect for the environment, enable the reproduction of family and self-sustainable agriculture[4] (Tomorrow's Build, 2024).

Furthermore, these are adaptation strategies for the construction of floating cities. These technologies are being developed in Amsterdam (Netherlands), Malé (Maldives) and Kiel (Germany), and these projects are associated with flood protection barriers and walls. These cities are structured with the support of Solar Panels (which also float) and marine farms, a sustainable circular economy based on the production of mussels that serve as food for fish and consequently for humans, in other words, people fish at their doorstep. from home or feed on the algae and/or mussels just a few meters from their balconies, the fish feed on the algae and help fertilize it. These projects have government support and support from research centers and universities, such as the University of Kiel and Center for Maritime Studies in Marin (Netherlands) (DW Documentary, 2023).

Likewise, adaptation strategies are also considered: 1) Population management plans and activities for locations distant from flood-prone areas, 2) planting trees in urban areas of cities, 3) creating warning systems against cyclones and storms, developing agriculture with drought-resistant crops, 4) strengthening electrical grids, highways and bridges with better materials and design so that they can withstand extreme weather conditions (such as storms), 5) redesigning and making more sustainable communication systems , commercial operations and government policies, 6) preserve tangible and intangible historical cultural heritage of local communities and learn how over the years they have adapted to climate conditions, 7) offer training to communities, which suffer from natural disasters and climate change, to create strategies based on the characteristics of their territories (United Nations, 2015; NDTV, 2023).

As important as adaptation actions is climate resilience, which is the ability of human beings to adapt to climate change (United Nations, 1992; United Nations 2015). This is the adaptive capacity that enables the creation of structures composed of financial resources, technological resources, production of human capital through education strategies and social capital, equipped with networks of trust and collaboration between groups (Climate Literacy, 2014). Resilience and adaptation go hand in hand.

Climate resilience is characterized by innovations in planning that provide rapid responses to communities damaged by climate events so that they can recover and be prepared for future disasters.

[2] There are projects of this level in Venice, Amsterdam, New York, on the coast of the state of Texas.
[3] This is the case in Chinese cities.
[4] Copenhagen, Denmark and Malé in the Maldives are examples.

These are examples; 1) flood insurance, which can promote resource allocation that prepares communities to deal with future disasters; 2) emergency response training; 3) strategies for storing essential supplies and establishing permanent and temporary reception centers for climate refugees; 4) building safe community networks capable of providing assistance during and after climate-related events; 5) diversification of community livelihoods to become less dependent on a single sectoral activity that may be affected by climate change, as well as 6) the protection and restoration of natural ecosystems, such as forests and wetlands, which can provide natural buffers (NDTV, 2023).

Actions around the world and research demonstrate that climate resilience can and should be structured based on effective and efficient systems that are more durable and resistant to climate change, as well as resilience is related to how much a system can yield, be changed before being impacted by climate change.

Tom Di Liberto suggests that institutions and societies follow some steps to create resilience, strategies must be produced based on territory-institutions dialogue. The first step would be to map which territories and landscapes are at risk from climate change, then it is necessary to assess the level of vulnerability/risk and thus formulate a ranking of priorities to address the most urgent cases; the third step is to create working groups to debate and list all options with the aim of reducing risks; the next step would be to rank the options based on "The benefit-cost ratio (BCR)", select options to implement, define success metrics and build an action plan; the fifth stage is in the field of action, therefore, it is necessary to obtain financing, implement the plan and monitor the results (HHS, 2022).

The adaptation plan of the European Commission's "Climate Change Adaptation Mission" proposes the construction of climate resilience (to create adaptation strategies) based on six stages within three major objectives. Step 1 is related to giving communities a better understanding of the risks related to climate change. This step is part of objective 1, which is to prepare and plan territories to develop climate resilience.

In step 2, the intention is to obtain support and involvement from societies and geographic regions through the creation, development and reinforcement (if already existing) of governance structures to guide transformation through inclusive and deliberative processes. In the third stage, institutions must support communities in formulating a future resilient to climate change through the formulation of based strategies and consolidated programs and plans, encouraging the creation of processes characterized by shared management and that dialogue with other strategies, thus creating cohesion in policies at different scales.

Phase 4 consists of orchestrating and testing transformative solutions based on the results of the previous stage, the intention being to develop paths that respond to the political challenges raised, which means:

a) map potential ecological corridors, create ecosystem restoration plans and test solutions based on the characteristics of the environment;
b) develop sustainable and efficient water use regimes to reduce vulnerability to use risks;
c) create mechanisms to develop agriculture, fisheries and forestry and food systems that are more resilient to climate change;
d) develop projects that aim to encourage the creation of infrastructures based on green technologies to promote the regeneration of public spaces, establishing cities with neighborhoods resilient to climate change;
e) Think about solutions to promote health services aligned with the context of climate change to cover vulnerable and marginalized populations;
f) Develop social mechanisms that guide and raise awareness about the importance of climate issues to increase the involvement of different segments of society;
g) Promote the creation of requalification and qualification programs for the workforce at the local/regional level;
h) Create solutions to fill gaps that may exist in protection systems as a result of losses caused by climate impacts; It is
i) Promote solutions to increase social resilience, particularly among the most vulnerable groups.

Steps 2, 3, and 4 (and the solutions mentioned above) are elements of objective 2 of the plan, aiming to accelerate the transformation processes related to climate resilience. Step 5 is to encourage the larger-scale deployment of tested solutions for climate resilience. In this case, the European institutions that coordinate the projects aim to provide support for the territories and communities involved to have access to the best available technologies and to encourage cooperation between more developed regions and those with less development and peripheral regions in terms of facing the impacts arising from climate change and adaptability. At this stage, the participation of public institutions is of utmost importance.

The sixth part of the process aims to promote the sharing of climate resilience projects. As this is the European Union, the orientation is to carry out cross-border sharing between regions and communities. The intention is to create large-scale cross-border demonstration projects to reconcile, reconcile visions and adaptation paths in different territories, in addition, the scope is to implement

shared and jointly developed transformative solutions, mainly to address the shortcomings and ineffectiveness that unilateral projects come and present.

In this way, it is possible to mitigate risks on both sides of borders and state borders and create joint solutions such as water capture/allocation in transboundary river basins, protection and connectivity of areas, forest protection in border areas, control of water and water pollution air and soil protection and against flood risks, etc. Furthermore, border regions will be able to develop and implement common strategies for cross-border cooperation in emergency management, health and social services, industrial specialization and other areas. Steps 5 and 6 are strategies linked to objective 3, which deals with demonstrating systemic transformations for climate resilience.

It is extremely important that climate adaptation and resilience actions are equipped with local strategies, appropriate to the reality of the territory and the cultures that interact within it. The Global Center on Adaptation (2014) suggests that to promote Locally Led Adaptation (ALL) actions it is necessary to follow eight principles:

1. Return "bottom-up" decision-making mechanisms. This gives communities direct access to financing and the power to deliberate according to their demands and realities;
2. Address structural inequalities faced by women, young people, children, people with disabilities, indigenous peoples in situations of deterritorialization and refuge and marginalized ethnic groups, which makes the voices of the most vulnerable communities heard, reducing inequalities;
3. Provide medium and long-term financing that is predictable and easily accessible;
4. Another central element of the ALL principle is investing in local capabilities to leave an institutional legacy. Local institutions are key to understanding climate risks and uncertainties, generating solutions, and facilitating and managing long-term adaptation initiatives. It is important to create autonomous local institutions and capacities, with expertise to obtain resources, so that they do not necessarily depend only on large project financiers;
5. The fifth principle addresses building a robust understanding/awareness of climate risks and uncertainties, which is based on informed adaptation decisions through a combination of local, traditional, indigenous, generational and scientific knowledge. This allows the creation of resilience in relation to future scenarios;
6. Flexible programming and learning is the sixth principle. In this way, it is possible to create mechanisms that allow adaptive management aimed at addressing the uncertainties inherent to climate change;

7. Ensuring transparency and accountability in processes is, therefore, the seventh principle; It is
8. Promotion of collaborative actions and investments. In this way, guarantees are created so that different initiatives and sources of financing support each other.

These principles can be fundamental for connecting local knowledge and climate science, and more, for building what Victoria Herrmann calls “legacy preservation”, as well as of paramount importance for empowering local communities with technical training and resources to become resilient. and create climate adaptation plans containing what matters most to their realities, to develop a more appropriate approach to their cultural heritage (Change Now, 2024).

Furthermore, the researcher highlights the importance of studying the history of communities around the world to discover how riverside, indigenous, quilombola and other societies have adapted to climate change over the years and centuries. Victoria Herrmann highlights that preserving and valuing heritage enables societies around the planet to become 1) researchers, so that by asking questions about the past they create collective climate awareness to find out how and why their territory was changed); 2) innovative citizens, therefore, capable of creating local adaptation solutions) and 3) communicators and storytellers, in this way, not only share stories of resilience and adaptation to climate change, but create positive narratives so that a universal awareness about the climate change and the need to lead a sustainable life (National Geographic Education, 2024).

Herrmann, when contacting different communities in the United States, recorded numerous adaptation technologies led by local communities. In Shaktoolik, Alaska, the locals have sustainable houses, as temperatures are increasing in the region, they decided to paint their houses with bright and varied colors, the colorful residences soften the temperatures in the urban perimeter of the village, in addition, they built their own system sewage system and installed their own renewable energy generation system. Some leaders surveyed what renewable innovations could be created, obtained resources, built the sanitation system and purchased two wind turbines to generate clean electrical energy and installed it (Creative Mornings HQ, 2019).

In Point-Aux-Chennes, Louisiana, riverside communities that have lived by fishing fish and shrimp from the region's rivers for centuries, including houses located on the banks; as a result of climate change, increased temperatures, strong storms and hurricanes with greater frequency, which in recent years have been altering the local ecosystem, with great resilience, they found solutions to the problems; they planted new species of trees that are resistant to salt water and started to cultivate different types of vegetables and fruits with greater power to adapt to climate change. In Miami, members of a small community called Little Haiti (which suffer from strong storms and tornadoes) mobilized, raised awareness and reconfigured their public and private spaces, created “green spaces”

in different parts of the urban center, installed grass in backyards, reconstructed public parks, and reconfigured schools and other commercial and business establishments with gardens, lawns, and other sustainable technologies to retain rainwater (National Geographic Education, 2024).

In Bangladesh, coastal communities 1) built dikes and barriers to contain floods with local resources; 2) they adapted their homes by installing bunkers and mobilized to obtain resources and training from institutions that deal with the climate issue; 3) created a) preventive plans that contain coordinated removal and displacement from sites; and b) training to adapt before, during and after the climatic event; 4) created environmental awareness programs, including the practice of growing food resistant to climate change (United Nations, 2015).

There are numerous adaptation strategies; managing water use, improving food security, creating "green spaces" "blue spaces" in cities and disaster management policies based on ancestral knowledge (HHS, 2022b). Furthermore, the world is full of stories of how different communities in different parts of the world are creating and executing climate adaptation strategies based on training from specialized institutions and based on the climate resilience they have developed over decades. These experiences are proof of what people can do when they have an opportunity to share knowledge and receive technical training from institutions.

Mitigation: Connecting science, nature and ancient knowledge to help the world

Climate mitigation actions aim to combat the causes of climate change. As we have already mentioned, there are currently three major global agendas that address the issue, the 2030 Agenda, the Paris Agreement and the Sendai Framework for Disaster Risk Reduction (NAP, 2020).

The agendas connect and discuss the reduction of greenhouse gas emissions, policies and strategies for the creation of "green technologies" with the aim of decarbonizing transport and producing clean and efficient energy and policies for the prevention and management of environmental disasters. Furthermore, they have common strategies and objectives based on the concepts of mitigation, adaptation and resilience.

Regarding climate mitigation, there are a series of studies and actions underway in different countries around the world, there are studies for decarbonization of transport, building resilient cities, creating "green jobs", producing "green technologies", etc. These processes occur through dialogues between the public and private sector and efforts are presenting innovations that will be important in the context of green transition.

In the context of the transition from fossil fuels to sustainable fuels, in addition to electric vehicles, there are other transport decarbonization processes. In Singapore, there are already projects underway to put into circulation ships fueled by liquid hydrogen or more precisely "green hydrogen",

the big challenge is to produce the fuel at affordable prices on the market and from clean and renewable energy. The success of this project means enabling a second decarbonization alternative for the maritime industry: the use of ammonia as fuel. However, “green ammonia” can only be produced from “green hydrogen”. Both fuels are clean alternatives even for electricity-based transport (CNA Insider, 2023).

In Singapore, the project is being carried out through partnerships between the public and private sector. The National University of Singapore has created a Hydrogen Innovation Center and is being financed by the company Temasek, both of which are Sembcorp Marine Ltda and Shell.

Other intense research aimed at mitigating climate change is being conducted in Iceland and Germany. In Iceland, green technologies are being developed based on the combination of geothermal energy, volcanic rocks and water. The first of these is the carbon capture plant, called Orca by its creators. The machine is made up of giant collectors that filter carbon dioxide (CO2). The filter captures the CO2 molecules while releasing cleaner air back into the atmosphere. Once the filters are full, the compartment is closed and the Orca then emits a wave of heat at around 100°C, produced by renewable form from a geothermal plant, which frees up CO2 to capture and collect. The equipment has the capacity to absorb 4,000 tons per year, negligible compared to the 36 million annual greenhouse emissions, but it is an innovation that in the future will have greater absorption capacity, in addition to becoming an important local tool in the present in the fight against global warming.

Another important GHG absorption tool is being developed by Carbfix, the method consists of permanently storing CO2 in rocks of volcanic origin. Carbfix created a geothermal plant to absorb polluting gases in which a 13-meter-long tower dissolves 15 thousand tons of carbon dioxide and 8 thousand tons of hydrogen sulfide in water every year. The plant absorbs the CO2 and then injects it into the basalt rock, where it forms solid carbonate and sulfide minerals. The process sequesters large amounts of GHG.

In Germany, the Max Planck Institute of Meteorology in Hamburg is carrying out research with the aim of developing an artificial shield to protect the earth from the sun's rays, that is, creating a giant parasol to cool the entire planet. It sounds crazy, but the idea originates from a natural event.

In 1991, the Pinatubo volcano erupted in the Philippines and ejected sulfur gas into the stratosphere, where it reacted with oxygen to form small particles, forming a thin layer that reflected and blocked sunlight, creating a giant shield of sorts. of umbrellas for the region that was hit. For months, temperatures were half a degree lower than normal. The event inspired researchers. According to Doctor Ulrike Niemeier, it is technically possible to create a shield against the sun; The big question is knowing how to assess the impacts and climate consequences of artificially emitting

sulfur into the stratosphere; it could alter rainy and dry seasons, which would harm agricultural activities. Researchers are still not sure how much sulfur would be needed and how many annual applications would need to be made (sulfur has a shelf life of one year) to maintain a constant layer. Niemeier believes that in a few years suitable aircraft may be available to carry out the technical intervention (DW Documentary, 2023).

The cement sector is also presenting solutions to mitigate the effects of climate change, the cement industry is one of the biggest polluters around the world and in order to contribute to the green transition process it has been presenting alternatives that consist of the creation of green technologies, in this case “green cement”.

ECOCEM LAB, from the company Ecocem, is developing research and carrying out tests with the aim of rethinking the cement industry with low carbon products; is developing a type of cement that uses as little polluting materials as possible. Concrete is made up of several different ingredients, including clinker, which is the most polluting part of cement. Clinker is composed of limestone and shale minerals, which when heated release polluting gases. Ecocem's new technology aims to minimize the clinker content of concrete, the product they are developing has a 20% reduction in mixing compared to other raw materials, in addition, they are reusing waste from steel manufacturing, mixing the leftovers in cement to reduce carbon emissions.

This is a finite resource, but it is an effort to mitigate the effects of climate change in cities. Most importantly, this venture contributes to expanding research actions in the cement sector in search of green innovations.

In order to produce more resilient and sustainable cities, Norway has become a pioneer in green transition policies and actions. Oslo, for example, aims to reduce CO2 emissions to close to 0 by 2030. A series of measures were taken to achieve the objective, the city hall created laws that facilitate 1) the installation and financing of “green spaces” in the city, in schools and private properties, 2) the use of clean energy in homes (through solar panels) and sharing of energy between neighbors. Furthermore, 3) it is promoting the civil construction sector through zero carbon constructions, through policies guiding the real estate and civil construction sector to reuse, reuse materials and merge new with old constructions. Buildings are responsible for 40% of carbon emissions and energy use worldwide; Therefore, the policy in Oslo is to mitigate the damage of global warming in the city by reconfiguring the use of the problem to provide a solution (DW Documentary, 2024)

Another example of innovation to mitigate the effects of climate change is the Norwegian city of Trondheim. In 2019, a building was opened in the city's port region: the “Powerhouse”. The urban equipment is an example of sustainable construction, it was designed to defy extreme weather

conditions and redefine the concept of energy self-sufficiency in the area of architecture. The project's creators created the building with the aim of achieving three objectives: 1) maximize the production of renewable energy; 2) optimize energy consumption, minimizing uses for building maintenance and 3) create a comfortable and practical environment for people's leisure (ArchDaily Brasil, 2019).

The property's roof is covered with solar panels at ideal angles to capture the sun's rays. The building has 3,000 square meters of panels and produces an annual average of 500,000 kilowatt-hours of electricity, more than double the amount it consumes. In this way, surplus electricity is used in a local microgrid that supplies neighboring buildings, buses and electric cars, in addition to the local community that uses nearby infrastructure (AV, 2024; DW Documentary, 2024).

In China, the world leader in the green transition process, the government has undertaken an ambitious project to provide the country with large parks with solar panels in mountainous regions, under the waters of rivers and lakes and desert areas, the intention is to supply its mega cities and industrial plants with clean energy, in this way, China mitigates damage to the environment, reduces production costs in its economy (since an economic structure based on fossil fuels is expensive) and generates millions of jobs.

One of the major projects is the solar panel plant that is being installed in the Tengger desert, which will become one of the largest plants in the world with the capacity to supply two million families with electricity. Furthermore, this technology will accelerate production in Chinese industry; as it will become the holder of one of the largest sources of cheap energy production in the world, as well as accelerating the production of innovations in the global context ((DW Documentary, 2024b)

Another action worth highlighting is that of the company PYREG GmbH located in Dörth, Germany. The company is developing a pilot project whose raw material is organic waste in which plants naturally store carbon. The venture consists of using waste materials from the production of wood chips, obtained from the forest (and any other dry plant residues) to produce biochar or biochar. Furthermore, PYREG is equipment that does not produce harmful gases and processes waste in a much cleaner way. It is a biomass for agronomist use, a soil conditioner, which works like a sponge, which connects and stores nutrients and water, therefore, it requires less water in production, very useful with the increase in temperatures and decrease in rainfall in some regions (DW Documentary, 2024).

Fast-growing forest species such as eucalyptus are ideal for transforming into biochar. In Brazil, Embrapa carries out research in this sector, however, there is no legislation in the country that regulates the production and analyzes the quality of this biomass. The technique comes from pre-Columbian people who lived on the banks of several rivers in the Amazon region, between Rondônia

and Alto Rio Negro and the Amazon River delta regions (Maia et. al., 2021).

In Senegal there is a superfood that can be grown in dry and desert areas and the technique comes from ancestral cultures in Africa. This food is fonio, a grain that is being recommended by the UN to resolve the issue of food insecurity on the African continent. Fonio is being recommended because it is a better alternative to corn and wheat crops, which are not adapted to most African regions and have to be imported. Fonio, in addition to adapting to dry climates, germinates in a few days and can be harvested in six weeks, is nutritious, tasty and can be stored for longer than other grains; Furthermore, it grows naturally, without chemical additives (Sossego da Flora, 2022)

Furthermore, as fonio grows in locations with a dry climate (such as the Sub-Saharan Sahel), in soils with low fertility rates, it does not require large amounts of water to be cultivated (much less water is used than rice). In addition to easily dealing with drought conditions, the grain rejuvenates the soil as it grows (Ramos, 2020; Gates, 2024). In this way, as it grows in soils where none else does, it becomes a global response against climate change, it is food that can be produced in times of drought, adaptable and with little water.

In Kenya, the company CAA in partnership with the company Terra Ingredients are already negotiating the insertion of the grain in American lands and some European countries are already beginning to expand the market for the food (Gate, 2024; CBI, 2023). The Kenyan company CCA has developed equipment to process fonio, accelerating stages of the harvesting and production process.

The grain is difficult to harvest, it is very small, the size of grains of sand, after harvesting it is necessary to remove the husk, a step that has been traditionally carried out for centuries by women from the Sahel, the technique consists of crushing the husk with your feet, then it takes six to seven hours to wash, dry and pre-cook. The equipment developed by CAA facilitates the process by speeding up the steps (Gates, 2024). Another case of creating technology and techniques based on ancestral knowledge. Fonio is another fundamental element in combating climate change.

Therefore, the debate on climate mitigation is very broad, it is related to investment in research, appreciation of ancestral cultures, articulations between the public and private sector and interdisciplinarity.

CONCLUSION

As it was possible to observe, mitigation, adaptation and resilience strategies are being developed based on different knowledge, these are debates that go beyond the discussion about conserving or preserving the environment or creating conventions based on given disciplinary and governmental knowledge. Such strategies called for breaking paradigms, valuing popular cultures

and connections with science, interdisciplinarities, multidisciplinarities, partnerships between the State (through universities, research centers, financing, etc.) and the market (corporations, private laboratories, etc.) and expansion of democratic spaces.

We chose such examples because our intention was to demonstrate the dialogues between different worlds, sectors and realities. This is not about "copying", but about asking: How can we carry out such actions in Brazil?

That is, how did companies achieve knowledge about fonio? How are the Chinese creating sponge cities? How can we value ancestral cultures to create resilient cities? How do you discuss policies? Is it only in parliament? How can we create spaces for deliberation in municipalities to reflect on climate policies? What is the role of the university? Is it with research? Is it helping with consultancies? Is it creating a multi, inter or post-disciplinary teaching system? How are engineers, architects and chemists around the world talking to geographers, anthropologists and historians to think about new urban planning?

It is impossible to answer at this moment, but it is clear that we need to start thinking more intensively about these and other issues in Brazil. The recent climate tragedy in Rio Grande do Sul is a warning sign. For a month now, RS has been suffering from severe flooding, with 471 cities affected, 169 deaths, 600,000 homeless and climate refugees. In May, more than R$1 billion in federal resources were allocated to assist the affected municipalities, as well as a solidarity support network had to be created to help the victims of this climate catastrophe.

We found the creation of the support network (with many volunteers) around the tragedy to help the victims very noble, as well as the response of the current executive and legislative power in Brazil being extremely important. However, the climate catastrophe shows how necessary it is to rethink urban planning in Brazil; expand dialogues between sciences at the University; changing the profile of political leaders, expanding the way of thinking, debating and deliberating on public policies and, above all, demonstrating how Brazil and, specifically, Rio Grande do Sul, needs to accelerate its policies regarding mitigation and adaptation.

Furthermore, Brazil needs to think more intensely about the global issue because it is positioning itself as a global leader in the fight against climate change, so it must start promoting responses. We believe that it is time to create a great national awareness around combating climate issues to discuss how global agendas on the subject can be materialized and for a major plan to combat climate change to be put into practice in Brazil based on current official documents and proposals and experiences around the world.

In this way, in order to contribute to the creation of this great national awareness, the Brazilian university together with the National Council for Scientific and Technological

Development (CNPQ), Coordination for the Improvement of Higher Education Personnel (CAPES) and other state funding agencies in Brazil; they could articulate the creation of a National Sustainability Research Plan (NSRP), with standardization of deadlines, goals and objectives. Products must be purposeful, that is, articles, books, reports, websites, lectures, podcasts and other PNP products must propose sustainable solutions suitable for different Brazilian territories, but specifically, analysis, communication and action methodologies.

When we refer to evaluation methodologies, we allude to the creation of applicability techniques to analyze official documents, theses, dissertations, reports and other techniques, which make it possible to think about propositional instruments based on the goals of the 2030 Agenda, in particular mitigation and adaptation strategies. As for communication methodologies, we refer to the creation of tools that collaborate and can help improve institutional dialogues to create and implement policies. The NSRP can create devices that can envision interaction, in the planning order, between different state apparatuses and civil society agents. A sustainable conscience requires the expansion of democracy and, above all, the overcoming of conflicts between planning units. In fact, the intention would be to think about supranational dialogue mechanisms that contribute to international cooperation actions for development and that enable the search for exchange and financing, based on mitigation and adaptation actions carried out around the world. The methodology of action is related to the way of applying knowledge, therefore, it is necessary to have well-defined variables to materialize an idea, hence the intention of structuring the PNP to propose a method that takes into account the different territorial realities of Brazil, the realities institutions and existing methodologies and strategies for promoting mitigation and adaptation strategies.

In general, the methodologies created from the NSRP would be useful to create a set of social technologies that enable the production of green technologies. These tools can be proposed based on the relationship between the concepts and objectives of the 2030 Agenda, based on the strategic axes of the Ecological Transformation Plan (PTE) and based on Law Nº 10.973/2004 (Innovation Law). The proposal we present here is, above all, related; the need to start producing purposeful academic content, in order to use knowledge to produce sustainable policies.

In short, the discussion we presented was a small effort to broaden the debate about the strategies and results that are being achieved based on SDG 13 and that involve adaptation, resilience and climate mitigation actions. As we already mentioned, the intention here was to raise questions.

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