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ANALYSIS OF TECHNOLOGICAL RESOURCES THAT CONTRIBUTE TO THE IDENTIFICATION OF PATHOLOGIES IN THE ENVIRONMENT

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Abstract: This article, made in the subject Trabalho de Conclusão de Curso II, of the Licentiate Degree in Biological Sciences, at the Distance Education Center of the University of the State of Santa Catarina, has the goal, to analyze the technological resources that contribute to the identification of pathologies in the environment. The methodology used is exploratory and bibliographical, with a qualitative approach. The results pointed to potential current technological tools, which are capable of detecting pathologies in different organisms. Such tools are useful for scenarios of environmental degradation, from which contaminants that cause pollution in habitats and diseases in living beings need to be detected. There are innovative technological resources that can control, monitor, and fight against environmental degradation, which is an essential factor for life on the planet following the principles of Sustainable Development.
Keywords: Environmental Pathology, Technologies, Environment.

INTRODUCTION

The search for new technological tools for monitoring, controlling and combating the environmental disaster scenario is leveraged according to demand, a demand that is always on the rise, but the idea is to turn this into solutions to combat this recurrence, becoming a more conscious organization, responsible and less polluting.

In times of epidemics and pandemics, technology is the most sought-after resource in the use of pathological detection, the identification of pathologies in the environment results in the efficiency and effectiveness of the control of contagious diseases and, consequently, results in the fight against these diseases by tracking contaminants in the environment that are directly linked to the causes of various environmental impacts.

Environmental degradation is a problem in the environment as a result of human attitudes and because of this exacerbated exploitation, many pathologies have emerged in organisms. In this sense, the following questions are raised: What technological resources available contribute to the identification of pathologies caused by contaminants in the environment? Do technological resources help to monitor and restore a degraded area?

The proposed general objective is to analyze the technological resources that contribute to the identification of pathologies in the environment. And as specific objectives: research technological resources that can be used to identify pathologies in the environment; list technological tools for combating and monitoring contaminants in various organisms and their definitions; verify possible applications of technological resources in areas of environmental degradation; list the resources most used in the identification of pathologies in the environment.

Technology and respective innovations are themes on the agendas of world conferences, governmental, industrial and business organizations, which encourage research, aiming at sustainability in various sectors and social segments. In this context, society is already recognized as a society of technology and knowledge, due to the rapid development of information and communication technologies, which have transformed the lives of the vast majority of the population. These favored and allowed researchers to carry out relevant investigations, in the economy, in health and in the environment, bringing significant knowledge to people.

THEORETICAL FOUNDATION

ENVIRONMENTAL PATHOLOGY

The term 'pathology' has a Greek origin (pathos = disease, suffering; and logos = study,

doctrine) and is widely used in Medicine, Dentistry, Veterinary Medicine and the study of plant disease. In this case, it is also known as Phytopathology, a word that comes from the Greek (Phyton = plant; Phatos = diseases and logos = study).

For the author Brasileiro Filho (2019, p. 1), "Pathology can be understood as the science that studies the causes of diseases, the mechanisms that produce them, the places where they occur and the molecular, morphological and functional alterations they present". Therefore, it integrates the study and research in the areas of Health and Biological Sciences.

The relationship between the environment and man has been marked by strong anthropic actions (environmental impacts caused by human actions). With the development of the productive and industrial sector, this mark in nature has become more aggravated, requiring human beings, as a rational and conscious species, to establish solutions for environmental monitoring, as well as restoration, recovery and artificial solutions. These methods are based on the study of degraded areas (habitat loss; overexploitation), sources of pollution and diseases resulting from and recurrent from environmental imbalance (introduction of species; overexploitation). All this imbalance, as a consequence of human exploitation, has presented several diseases, ranging from a small local scale to a global scale of infection (pandemic). Thus, the pathology is being widely used within the framework of environmental diseases, giving rise to the term 'environmental pathology'.

According to Hansel and Dintzis (2007, p. 164), "Environmental pathology deals with diseases caused by exposure to harmful external agents and deficiencies of vital substances. It covers all nutritional, infectious, chemical and physical causes of disease."

Pollution brings environmental imbalances, and can even cause irreversible damage to organisms, in such a way as to harm an entire food chain. According to Scottini (2014, p. 654), pollution is "dirt, stain, infection, environmental degradation with various types of garbage; destruction of healthy livelihoods".

Environmental pathology is associated with pollution, and it is the study of diseases in organisms exposed to toxins that produce exogenous (from the environment) and endogenous (from the organism itself) lesions. According to the author Brasileiro Filho (2016), exogenous lesions are designated by physical, chemical, biological agents and nutritional imbalance; endogenous lesions, in turn, are represented by issues of genetic heritage, the body's defense mechanisms against aggression and emotional factors related to the social environment.

> Physical agents include mechanical force (trauma), radiation, temperature variations, and atmospheric pressure changes; chemical agents encompass a huge variety of toxics, such as pesticides, environmental pollutants, food contaminants and numerous other substances, including drugs and illicit drugs. Biological agents are represented by mycoplasmas, rickettsiae, viruses, bacteria, protozoa and metazoa. Nutritional disorders involve both nutrient deficiency and excess. In all these conditions, the role that the genetic heritage plays in the appearance of diseases is indisputable, as each individual reacts to the environment in a particular way, a property that is related to their genetic constitution. (BRASILEIRO FILHO, 2016, p. 35).

Pathologies can exist both in fauna and flora. If the water system is contaminated, it will affect everyone who consumes the water, whether wild animals, domestic animals, humans or plants.

Through homeostasis (homeo = equal, estasis = state), the ecosystem is able to

control its structure and function, such as resistance to toxins, pollution and resilience in its ability to absorb pollutants. However, there are patterns of contamination that are irreversible, when the ecological capacity is disturbed and exploited to the maximum in impact numbers. In this case, these frames are summarized as environmental stress or environmental impact.

Pollution is mostly associated with population growth, where there is greater formation of urban and industrial areas, road lines and greater circulation of cars, damaging the air. Human consumption often becomes too much, removing vegetation cover and destroying biodiversity. This leads to environmental imbalance, with consequences for the proliferation of parasitic species and insects that are fought with heavy pesticides, which are pollutants in waterways, soil and air.

According to Botkin and Keller (2009), Biology is important for environmental science, especially in ecology that deals with the relationship between living beings and their environment. Thus, the term pollution is linked to ecology, as it refers to the effects on the ecosystem's livelihood, allowing, from that, an assessment of the degree of pollution being moderately or highly polluted through the characteristics of a community.

For Chinalia (1997, p. 8),

> This analysis is carried out in the observation of possible reproductive, physiological and biochemical alterations of the species, from a structural and functional perspective of the ecosystem that, if polluted, will present poverty of local species and less uniformity in them.

Therefore, for environmentalists, sustainability must be taken into account within the productive sectors, as well as in the environmental and educational sectors, so that there can be an increase in environmental quality and, consequently, the fight against recurring environmental pathologies, improving the quality of life.

TECHNOLOGY

The word technology, according to the Scottini dictionary (2014, p. 787), has the following meaning: "the study of how to do something better; science that studies work techniques; use of scientific knowledge".

The 20th century was impacted by the subjective transformations of Science and Technology that would trigger a revolution in the field of work production. Thus, industrial production in the 18th century had a greater impact on agriculture, as thousands of people migrated from rural areas to industrial areas, where they would have more work opportunities. This period shook people's minds, since the relevance of the Industrial Revolution would be the generation of wealth and modernity.

The application of technology in society has become something essential in contemporary culture, as it is increasingly innovating for the comfort of man, in addition to playing an important role in scientific development. According to Nobrega (2018, p. 9), "the truth about technology is in the ways that information is manifested in the world according to which the mind is still able to understand and interpret, always with a view to the future".

In his study, Hur (2018) brings a quote from Deleuze (1986/2014), in which he makes an analogy between technical machines and a chemical element. For Deleuze, second-generation machines were carbon-powered and third-generation machines replaced carbon with silicon, being cybernetics.

> The subject is the system called man-machine. The energy machine did not form a man-machine system with man. What form a man-machine system with man are third-generation machines, our machines, the machines of our age, the age of silicon.

> (DELEUZE, 1986/2014, p. 236, apud HUR, 2018, p. 175).

Hur (2018) complements the philosopher Deleuze's classifications in three divisions of man-machine and its time of technological evolution, being the time of the first generations of machines, which deals with the pulley and watchmaking mechanisms in the Classical Age; then the second generation, which refers to steam, combustion and energy engines in the 19th century; and the third generation of current times, aimed at computerized machines.

According to Castells (2000, apud NICOLACI-DA-COSTA, 2002), these technological developments — in the late 18th century, the discovery of steam energy, and in the 19th century, the invention of electrical energy — were different and their gaze provided stability in the understanding of the revolutionary industrial and technological logic, as they managed to affect economic and social systems.

Currently, the industry is involved in yet another revolutionary technological process, which is in constant evolution and transition. Author Mazzaferro (2018, p.1) explains that "the so-called Industry 4.0 translates into the existence of intelligent sources, extensive use of robotics, reliable data processing and storage systems."

For the author Mazzaferro (2018), the technological revolution and the years of research and development bring benefits to technical knowledge and the dissemination of information for the proper use of technologies, as they help, through discoveries and errors, the advance towards solutions and technologies available.

ENVIRONMENTAL TECHNOLOGY

Attention given to the environmental sector is more likely to tend to emergencies regarding protection, exploitation or combat of any environmental disaster that has occurred, which directly affects or affected human relations. This sustainable trend has been a challenging and urgent matter for human beings, as there is a constant need for improvements in current environmental conditions, which arise more frequently from catastrophes.

Issues about environmental technologies had already been reported in Agenda 21, stating that:

> Environmentally sound technologies protect the environment, are less polluting, use all resources more sustainably, recycle more of their waste and products, and treat residual waste in a more acceptable way than the technologies they replaced. (BRASIL, 1992, p. 337).

The development of hardware or software is essential for the improvement and environmental performance, mainly because the use of raw materials is so sought after worldwide within the productive sphere. Thus, there is greater attention and urgency from the environmental sector in this competitive race that is capitalism.

According to Lorenzetti (2012, p. 434),

> technology can be broken down into material products/'things' (such as products to satisfy needs) and non-material 'things' (work processes, certain knowledge constituted for the generation of products and even for organizing human actions) [...].

A large part of the technologies in the healthcare sector are also intended for the environmental sector, especially when it comes to pathological areas and pollution that directly affect humans.

The analysis of pollutants in certain places can be carried out using technological resources. An example is pollution in water bodies: for this water resource to be suitable for use, it is first necessary to undergo laboratory analysis and investigate possible pathological causes in living organisms that

use this water for consumption. Thus, they are used from statistical processes, software, to laboratory tools, through variables that enable the identification of possible sources of pollution and contamination.

Between pollution and contamination, there is a difference. Pollution is considered an alteration caused by anthropic actions, which causes serious ecological consequences, harming man who depends on nature for the maintenance of life. On the other hand, contamination can happen by anthropic actions or not, and it can be caused by environmental imbalance or by human intervention, but a contamination will not always be a pollution. Even though it is a contamination or pollution, it is always necessary to carry out an environmental analysis, thus determining, for example, the existing standards in water. According to Centeno et al. (2016, p. 1), "Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD520), Turbidity (TH), Kjeldahl Total Nitrogen (NTK), Total Phosphorus (PT), Water Temperature (TH2O), Thermotolerant Coliforms (CT), Total Solids (ST) and Hydrogenionic Potential (pH)" are the main parameters evaluated by the work of using multivariate statistics as a tool to identify possible sources of pollution.

The prevention of damage to the body resulting from chemical contaminants in the environment is a work that involves environmental health. Exposure levels are acceptable when they do not pose a biological risk to humans. Thus, there are several forms of technologies that are currently being used in the environmental area for detection, control and solutions within degradation scenarios involving human health.

METHODOLOGY

The methodology used is characterized as exploratory and bibliographical, with a qualitative approach. The exploratory research, according to Severino (2017), seeks to gather information about the object, in order to seek a mapping of the conditions that the presented object has to manifest. Gil (2010) reinforces that exploratory research provides familiarity with the problem, in order to be more explicit and enable the construction of hypotheses due to flexibility in planning. Such planning can be constituted by several aspects related to the studied phenomenon, such as data collection, bibliographic survey, among others.

The bibliographic research is carried out based on information analyzed and already published by researchers, with free access for all.

> Traditionally, this type of research includes printed material, such as books, magazines, newspapers, theses, dissertations and scientific event proceedings. However, due to the dissemination of new information formats, these researches started to include other types of Sources, such as disks, magnetic tapes, CDs, as well as material made available on the Internet. (GIL, 2010, p. 29).

The qualitative approach allows the analysis of information and meanings related to the researched topic based on the researcher's knowledge about the subject, avoiding subjectivity in their interpretations. From tables, representations can be obtained, and consequently, a better understanding of data collection to be disseminated.

The search for references in this article was based on keywords such as: technology, environmental technology, pathology, environment and others through CAPES Journal, UDESC library, scientific journals and Google Scholar, which facilitated the research.

Data were collected from scientific articles, printed books, e-books and websites that include content related to the topic of this article, all published between 1999 and 2021.

DATA ANALYSIS AND INTERPRETATION

The data presented below are taken from nineteen articles dated from 2002 to 2021.

All resources for the creation of technologies throughout history have brought consequences from anthropic actions in environmental pathologies. Inorganic beings in nature (water, earth, air) are chemically constituted, and once unbalanced, contaminated and polluted, generate a source of danger for organic beings that inhabit and use inorganic matter as their vital sustenance. In this aspect, technology can be considered a double-edged sword, which is for the exploration of the environment, but it is also for solutions to several environmental problems. Thus, environmental technological research and productions related to these issues were initiated.

Figure 1 represents biological tests that can be used to indicate a biological condition or disease.

Figure 2, on the other hand, represents the Satellite technology and informational images through remote sensing.

Figure 3 illustrates the operation of the SUFER 3D interpolation and visualization software.

In Figure 4, the use of Arduino in the environment is shown.

Figure 5 represents the manipulation of the method of combining synthetic DNA and carbon nanotubes.

Figure 6 illustrates Machine Learning and its myriad uses in the environment.

In Figure 7, shows the possibility of the equipment to carry out various monitoring and even detect pollution and pathologies in planting leaves.

It is showed (Chart 1) that not all the tools listed can be used to identify pathologies in the environment. Considering the applicability of each one, Chart 2 is formed, which lists tools for combating and monitoring the components that degrade organisms.

Combating contaminants (Table 2) with biomarkers in different organisms can happen due to the potential for early assessment or prediction used in the diagnosis of diseases (contagious, cancerous, immunosuppressed, infectious, allergic, among others). This combat is done by inducing pollutant variations in cellular components that can identify toxic substances. The guarantee of attenuation and combating pathological occurrences in these living beings happens due to predictions that indicate variations in the normal patterns of organisms caused by exposure to pollutants.

Monitoring (Table 2) with biomarkers in organisms is stated by the authors Amorim (2003), Lionetto et al. (2012, our translation) and Morado, Araújo and Gomes (2017). With this technology, monitoring occurs through a routine procedure with bioassessment of the exposure of organisms to polluting agents in environmental and biological samples. When organisms are exposed to pollution in their ecosystems, they undergo changes in their cellular, physiological and biochemical components. In this field, biochemical enzyme inhibitions are a means of monitoring the impact that chemicals have on organisms.

In the case of nanotechnology (Table 2), the authors Pepe (2014), Mehndiratta et al. (2013, our translation), Ferreira and Rangel (2009) and Abu Hashem et al. (2021) explain that monitoring sensors in nanoparticles can determine the physical, chemical or biological type of contaminants present in the environment, such as biosensors, based on nucleic acid (DNA and RNA = fundamental building blocks of life) and electrochemicals that detect small toxic molecules.

With regard to satellites (Table 2), the authors Zanotta, Ferreira and Zortea (2019) confirm that, regarding monitoring, the

Types of Technological Resources	Definition
Biomarkers	According to the authors Amorim (2003), Lionetto et al. (2012), Morado, Araujo and Gomes (2017), is a technology used in bioassessment programs (assessment of the biological condition of a habitat that uses a biological survey of the organic community that resides in that habitat), which measure its properties within an organism.normal patterns. It also measures how these biological patterns (cellular or biochemical components) react to environmental variations and effects when exposed to contaminants or medications.
Satellite	Conforme Reis *et al*. (2008), this technology orbits the Earth or other celestial bodies, and can be represented by space probes, shuttles and telescopes that enable images, illustrations and information about the earth's surface through remote sensing.
SUFER	Landim, Monteiro and Corsi (2002) state that this software is a 3D visualization interpolation technology, which can be used for creating maps, terrain modeling, surface analysis and mapping through spatially distributed variable data.
Arduino	According to the ARDUINO® website (2018, online, our translation) and the author Miranda et al. (2020), Arduino is a free software and hardware electronic prototyping platform, with input and output reading boards that have standard language in C/C++ library, and can be run on Linux, Windows and Mac operating systems.
Nanotechnology	The authors Ferreira and Rangel (2009), Batista and Pepe (2014) and Mehniratta et al. (2013) explain that it is a technology that manipulates nanoscale materials (atoms and molecules), which can create materials of the same scale, known as nano (10-9 m = 1 nm).
Artificial intelligence (IA)	According to the author Savage (2019, online, our translation) AI are artificial neural networks similar to networks of neurons in the brain, composed of sets of software, logic and algorithms that make a computer perform functions like the human brain. This technology is capable of identifying patterns in great complexityin data sets, how to perform calculations, perceive meaning in written and spoken language, learn, distinguish the image of a dog by comparing it to an object, detect pedestrians in motion, make a car automatic, recognize facial expressions, between others.
Drone	According to the website of the Brazilian Air Force (2015) and Pimenta (2018), Drone (drone) was called by this name due to the hum it produces when it is flying. It is a technology derived from the Unmanned Aerial Vehicle (UAV) and constitutes three-axle aircraft that are remotely controlled through electronic or computer controls..

Table 1 – List and definition of some technological resources that can identify pathologies in the environment.

Source: Elaborated by the author (2021), based on the authors AMORIM (2003); LIONETTO et al. (2012); ADDRESS; ARAÚJO; GOMES (2017); REIS et al. (2008); LANDIM; MONTEIRO; CORSI (2002); MIRANDA et al. (2020); BLACKSMITH; RANGEL (2009); BAPTIST; PEPE (2014); MEHNDIRATTA, et al. (2013); GOLDEN SOFTWARE (2016); SAVAGE (2019); ARDUINO®, (2021); BRAZILIAN AIR FORCE (2015); PIMENTA (2018).

Figure 1 – Biomarkers can be proteins, enzymes, antibodies and others found in blood or body fluids

Source: Nutritotal (c2021)

Figure 2 – Brazilian satellite Amazônia 1, capturing images of Ilha do Mel and Curitiba/PR

Source: INPE (c2021)

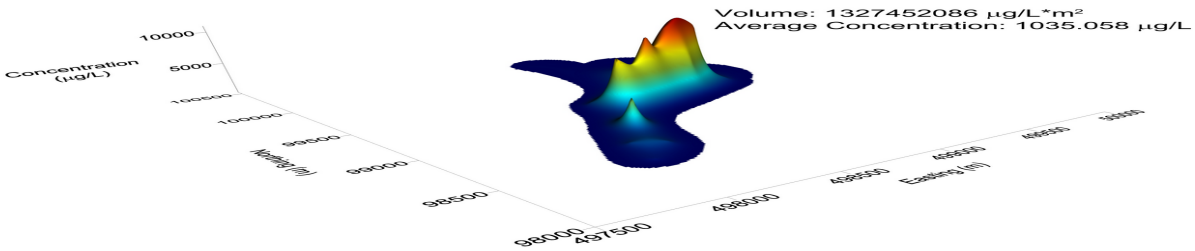

Figure 3 – Calculating the mean concentration of a contaminant plume using Surfer 14.

Source: Yoder (c2017)

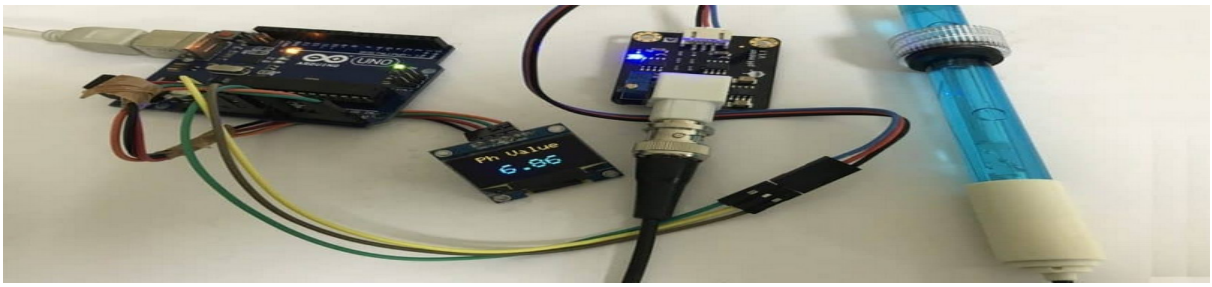

Figure 4 – pH meter with sensor, Arduino and OLED display.

Source: CapSistema (c2021)

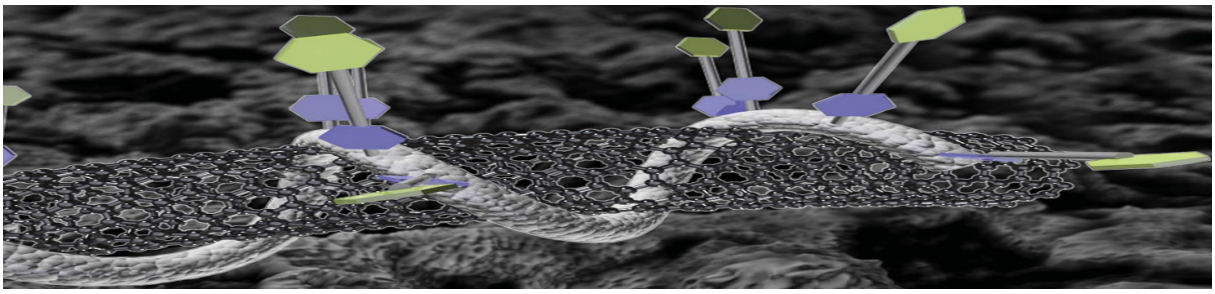

Figure 5 – Hydrophilic microbiosensor based on a single-walled DNA-modified carbon nanotube.

Source: Kurzweil (c2011)

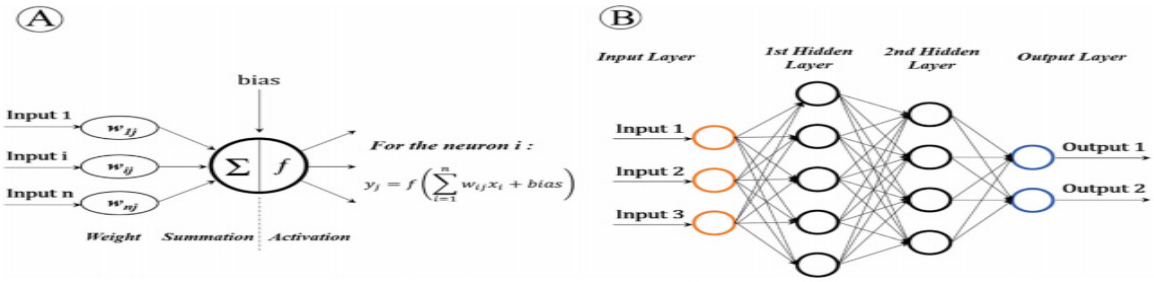

Figure 6 – MLPNN, training by backpropagation neural network algorithm, applied in the environmental pollution domainl

Source: Wang *et al.* (2019)

Figure 7 – Drone, from above, it is possible to analyze the color of the plant to detect the presence of fungi, for example

Source: Brazilian Air Force (2015)

creation of map technologies, climate data and geographic data is very useful in locating pathologies that are being foci of local contamination, which is why the satellites monitor delimiting areas at risk for diseases. This way, based on data about the terrestrial surface, it is possible to monitor contaminants in vegetation and populations that inhabit a certain region.

As for Artificial Intelligence (Table 2), authors Mottaqi, Mohammadipanah and Sajedi (2021) and Chenar and Deng (2018) contribute with the thought that Machine Learning (MA) can be used to identify new viruses. Thus, monitoring can be done in different places around the world. There are also a multitude of technological means of Artificial Intelligence (AI) currently being tested, used and applied for these monitoring of contaminants in organisms. It is possible to use AI technology as an effective forecasting and monitoring tool in the detection of epidemiological outbreaks.

After analyzing the technological resources for combating and monitoring contaminants in organisms, there are verifications of technologies presented in Table 1 for possible applications in areas of environmental degradation, as shown in Table 3:

Biomarkers (Table 3) are seen as technologies that are applied in early assessments of ecotoxicological pollution of ecosystems. The exposure of toxic substances in inorganic media (water, land and air) can be considered as pollution, as it brings consequences of these potentially toxic agents to the environment and to living beings.

Nanotechnology (Table 3) can be applied in the detection, prevention, control, reduction and combat of pollution through the manipulation of materials on a nanoscale, being very useful in areas of environmental degradation.

SUFER (Table 3), on the other hand, is an interpolation software applied to also designate contaminated and polluted areas, such as detection of plumes from greater depths and concentration of underground contaminants in degraded areas. It is also used to define the preferential flow of groundwater.

Satellites (Table 3) can be used to detect and monitor deforestation, fires, mining, among other types of environmental degradation. The use of satellites has given a boost due to environmental incidents.

Arduino (Table 3) is a platform that can be used in various environmental sectors. Through its sensors, it can monitor water quality by measuring pH and temperature, in order to identify residues in the water; it can also monitor land and air in scenarios of environmental degradation.

Artificial Intelligence (AI) (Table 3) is applied through Machine Learning processing. The AI has applicability in environmental degradation scenarios, such as environmental pollution control, estimation of pollutants in the aquatic and atmospheric environment, identification of polluted water characteristics and tracking of point sources of pollutants emitted by industries.

Finally, drones (Table 3) contribute to applications for inspection, assessment, detection of environmental pathologies and environmental impacts. The equipment has been successful for use in detecting fires, pollution and deforestation. It is an effective solution and tool when it comes to speed in the work of detecting environmental impacts.

"All automation, embedded electronics, software development and dedicated systems only translates into sustainable advancement that justifies the name of revolution if the much-vaunted results can be systematically obtained" (MAZZAFERRO, 2018, p. 1), that is, this advance can only be considered sustainable if it lives up to the meaning in its

Applications	Technological resources
Combat	Biomarkers
Monitoring	Biomarkers
	Nanotechnology
	Artificial intelligence (IA)
	Drones
	SUFER
	Arduino
	Satellites

Table 2 - Possible technological resources for combating and monitoring contaminants in organisms

Source: Prepared by the author (2021), based on the authors AMORIM (2003); LIONETTO et al. (2012); ADDRESS; ARAUJO; GOMES (2017); BLACKSMITH; RANGEL (2009); BAPTIST; PEPE (2014); MEHNDIRATTA, et al. (2013); ZANOTTA; BLACKSMITH; ZORTEA (2019); ABU HASHEM, et al. (2021); MOTTAQI; MOHAMMADIPANAH; SAJEDI (2021); SOURCES; POZZETI (2016); CHENAR; DENG (2018).

Technologies for applications	Biomarkers
	Nanotechnology
	SUFER
	Satellites
	Arduíno
	Artificial intelligence (IA)
	Drones

Table 3 – Technologies applied to assess areas with environmental degradation

Source: elaborated by the author (2021), based on the authors AMORIM (2003); VIVIAN (2015); INPE (2017); MIRANDA et al. (2020); MEHNDIRATTA et al. (2013); Wang et al. (2019); NISHANT; KENNEDY; CORBETT (2020); BRAZILIAN AIR FORCE (2015); GHAEDI; VAFAEI; FJ Li et al. (2017; 2016); YE et al. (2020); SOURCES;POZZETI (2016).

applicability. Thus, the technologies presented have potential application for identifying and analyzing environmental impacts, as well as for combating, monitoring and controlling environmental pathologies.

Biomarkers, or Biomarkers, are technologies applicable to the assessment of exposure to environmental chemical agents and to pathogen analysis, among other technologies. The software for interpolation called SUFER, as a technology applicable to contaminated environments, is created for the formation of maps using spatially distributed variable data. It can be used to designate contaminated and polluted areas, restricting them to human contact and working for environmental restoration, or isolating access to other water sources that may contaminate other elements accessible to man.

There are other technologies that are being developed and over the years have been improved, such as the Amazonas 3 Satellite and other ways of using hardware, such as Arduino and Drones. The Arduino is a system that enables research within the environment, it is little talked about, but it has ample space for creative use, being also of low cost for those who are encouraged to develop sustainable innovative technological methods. Drones, in turn, became popular due to their easy access to technology and their efficiency in combat and environmental monitoring. Also, currently, there is a demand and need for efficient, advanced, current and sustainable technologies, such as nanotechnology and artificial intelligence (AI). For Nishant, Kennedy and Corbett (2020, p. 1, our translation), "The true value of AI will not be in how it allows society to reduce its energy, water and land use intensities, but on a higher level, how it facilitates and promotes environmental governance."

World leaders (United Nations) adopted in 2015 the 2030 Sustainable Development Agenda, which includes 17 SDG goals that seek to balance the economic, social and environmental dimensions of sustainable development.

According to the UN (2015), the pillars of Sustainable Development are listed in:

- Economic development, which deals with poverty eradication, sustainable cities, economic growth, energy, infrastructure, industrialization, food security, agriculture, health, water and sanitation;
- Social development, which attributes the quality of education to the reduction of inequalities (including the active participation of women), to good governance and the means of implementation;
- Development of environmental protection in preservation over environmental degradation, focusing on climate change and the sustainable use of oceans and terrestrial ecosystems, replacing unsustainable development patterns with sustainable patterns of production and consumption at local, national and global levels.

Thus, sustainability is a crucial factor for the use of technologies on the planet, as it has also been inserted in cultural values due to the historical progress in the development of humanity, being an emerging solution to current problems that occur in a global domino effect.

FINAL CONSIDERATIONS

In this article, the investigation of available technological resources with possible applicability for detection, monitoring and combating of pathologies in the environment was carried out, which contributed to the scientific-technological corroboration of these tools in use in different scenarios of environmental degradation.

Research has shown that technologies are a source of knowledge and important tools, used in various techniques, which scientists, professionals from different sectors, the military and students can use in critical environmental health situations.

The sources that supported this article are premises for the development of new technological creations for faster solutions to environmental problems focused on detecting and combating pathologies in organisms, especially when they occur in large proportions.

However, some of these technological tools (Biomarkers, AI, nanotechnology and sensors) had limited records on their applicability in detecting pathologies in the environment, causing other more standardized tools to be used frequently in occurrences of environmental disasters and pollution, as sample collection techniques for laboratory analysis, preventing these tools listed here, for example, from being more elaborated or more developed to solve future pathologies in living beings.

The development of technological tools, considered cleaner and that contribute to the analysis of occurrences of environmental degradation, strongly favors the use of sustainable methodologies with the possibility of mapping toxic substances that cause outbreaks of environmental pathologies.

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