Chapter

Environmental Management and Data for the SDGs

Luiz Cruz Villares

Abstract

Ambient intelligence data is key for the global scope of climate, biodiversity, water, air pollution, and general environmental control. The account of carbon emissions, water and air pollutants, sea and freshwater life, and earth nature quality, are key for a healthy environment, in local or global concerns. Controlling initiatives and data management for the environment are part of sustainability strategies for governments, businesses, and entities in general. Such initiatives are increasingly connected to key mankind issues such as poverty, hunger, health, education, gender and equality, among others. Altogether, they are clearly addressed in the United Nations Sustainable Development Goals, to be met in 2030. The Sustainable Development Goals (SDGs) provide a relevant connection of environmental intelligence systems with public policies, research, international cooperation, and technology transfers. In a detailed analysis of their targets, they offer the stimulus for a vast array of technical applications linking sustainability issues with Ambient Intelligence technologies. The SDGs should be considered the benchmark for action towards a healthy environment given their global concern and interconnectivity of multiple issues related to a better quality of life. The SDGs should become, ultimately, the main driver for the spread of present and new technologies to promote better monitoring and control of the environment. The growth and advances of Ambient Intelligence technologies to new areas of knowledge should be enhanced by their connectivity with the SDGs.

Keywords: Sustainable Development Goals, Ambient Intelligence, AmI, targets, connections, interdependence, international cooperation, technology

1. Introduction

This chapter identifies several targets clearly outlined in the SDGs to be implemented with straight cooperation with Ambient Intelligence technologies. Such relationships shall promote a high level of Ambient Intelligence research, and the growth of technical and international cooperation within the Ambient Intelligence community for a better and more sustainable planet.

Following this introduction, this chapter has two parts and a conclusion, in brief, covering a description of the SDGs; a detailed analysis of each SDGs' targets and indicators linking with Ambient Intelligence technologies, and a conclusion.

The first part offers a primer on the SDGs, to set a common ground of knowledge about their importance and reach of all sustainability issues worldwide. Part two is the body of study in this chapter, presenting analyzes of all links among the SDGs and Ambient Intelligence issues. Each SDG is presented with a selection of targets presenting

connections with Ambient Intelligence, in technology, public policy, and general cooperation aspects. Given its general awareness, SDG 13, related to climate change receives a comprehensive attention. Part three is a conclusion of this study, aimed at raising the general awareness of research, development, and cooperation efforts, worldwide, on Ambient Intelligence issues for the SDGs to be successfully achieved by 2030.

2. Key aspects of the SDGs for ambient intelligence

The Sustainable Development Goals (SDGs) are the result of a United Nations Organization (UN) initiative for all its Member States to reach global sustainable development standards in 2030 [1]. Created in 2015 as a development from the Millennium Development Objectives, the SDGs are composed of 17 major goals with 169 targets and specific indicators for measuring their achievements, by 2030. The SDGs represent a clear guide to all humanity to reach high sustainable development patterns in this present decade. The implementation of these targets are addressed at national and subnational government policies, and non-government initiatives. Businesses in general, mainly large corporations, have been adopting the SDGs in their sustainability strategies, committed to the most applicable targets related to their operations, activities and socio environmental impacts. In brief, the global 17 goals for 2030 are (**Figure 1**):

1. End poverty in all its forms, everywhere.

2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

3. Ensure healthy lives and promote well-being for all at all ages.

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

5. Achieve gender equality and empower all women and girls.

6. Ensure availability and sustainable management of water and sanitation for all.

7. Ensure access to affordable, reliable, sustainable and modern energy for all.

8. Promote sustained, inclusive and sustainable economic growth, full and productive, employment and decent work for all.

9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

10. Reduce inequality within and among countries.

11. Make cities and human settlements inclusive, safe, resilient and sustainable.

12. Ensure sustainable production and consumption patterns.

13. Take urgent action to combat climate change and its impacts.

14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation, and halt biodiversity loss.

16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Figure 1.
UN sustainable development goals (SDGs). Source: United Nations.

As mentioned, each goal has specific targets with specific actions, totaling 169 targets. Overall, the targets are interconnected and complementary to each other, pointing to similarities with multiple cross-references among them, thus creating synergies for their implementation. The targets are enhanced by actions with common terms such as "reduce", "increase", "assure", "promote", "implement", "ensure" "halt", "improve", "support", "end", improve", among others [2].

These actions create interdependence among them, pointing to public policies, scientific research, funding and international cooperation issues. In this chapter, attention is placed on the SDGs' focus on environmental targets, hence closer to Ambient Intelligence. The standard analysis provided is the identification of targets connectable to Ambient Intelligence technologies as a general overview. In some cases, specific mentions are made to technologies, but the overall proposal in this study is to enlighten the SDGs and targets as major drivers to develop and spread the Ambient Intelligence solutions for sustainable development (**Figure 1**).

Following, this chapter is focused on listing each SDG and its specific goals related to Ambient Intelligence technologies. In some cases, a SDG may be not strictly related to the environment, but it brings specific targets related to Ambient Intelligence subjects. Henceforth, in the next part, Ambient Intelligence is abbreviated to "AmI".

3. Connections of the SDGs targets with ambient intelligence

Beginning, SDG 1, related to poverty, indicates general targets for humanity to reduce poverty, proposing overall measures and tasks, generally interconnected with all SDGs. As an example, Target 1.5 is about improving the resilience of the poor and all population in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events, as well as other forms of economic, social and environmental disasters. This statement brings connections with most of the other 16 SDGs, and specifically, calls for the improvement of general means of living involving the internet, connectivity, and the use of collective solutions for housing solutions to be fairly improved with AmI devices, such as smart energy consumption devices.

SDG 2 is related to zero hunger. Target 2.4 is to increase the production of food from sustainable and resilient agricultural practices, helping the maintenance of ecosystems, and the strength of human capacity to face extreme weather situations, such as drought, flooding and other disasters, thus improving land and soil quality. The indicator to measure achievements by 2030 is the proportion of agricultural areas under productive and sustainable agriculture. The main target here is to improve the proportion of sustainable land practices over traditional land practices. AmI devices provide multiple sensors for climate and land systems controls among other monitoring tools to enhance the natural resource management attached to good practices of land management. Weather predictions coupled with crop productivity and biodynamic techniques use AmI technologies for productivity, water and natural resources uses. Next, Target 2.5 calls for an immediate action, already by 2020, on the maintenance of the genetic diversity of seeds, cultivated plants, domesticated animals and their related wild species. Continuing, the target calls for the implementation of seed and plant banks at national, regional and international levels, and the management of equitable access to genetic resources associated to traditional knowledge. The indicators are the number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities; and the proportion of local breeds classified as being at risk, not-at-risk or at unknown level of risk of extinction. These are ultimate areas for AmI

devices to help a proper registry of species in the form of local and global banks of species, mainly, using Blockchain platforms to ensure data security and veracity. Biodiversity conservation and food security issues have increasingly become part of integrated efforts. These specifically mentioned SDG 2 targets are closely related to SDG 15, about life on earth.

SDG 3, related to good health and well-being, apparently provides connectivity to AmI in areas of public health, presently enhanced by the global Covid 19 pandemic, bringing much attention to AmI possibilities to cooperate with safer and cleaner ambients. For instance, cognitive technologies, such as machine learning, neural networks, robotic process automation, bots, neural nets, and the broader domain of AmI, have the potential to transform the human relation with critical health and safety situations, presently enhanced by all attention to Covid-19. In brief, AmI offers tools for medical professionals to have accurate predictions, fast reactions and interactions with critical health and safety situations [3].

An examination of specific targets reinforces the connections between AmI, health and sustainable development. Target 3.6 calls, already by 2020, for a decrease in the number of global deaths and injuries from road traffic accidents. The indicator is the death rate due to road traffic injuries. AmI and Internet of Things (IoT) devices installed in cars, in some cases connectable to road management, shall decrease the number of road accidents in the coming years, thus positively contributing to this target. Continuing, Target 3.9 has clear connections with AmI, as it aims at substantially reducing deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination. Water pollutants, hazardous chemicals and metals, and air pollution measurements, are clear objects of AmI devices and systems, already playing a major role in their monitoring. Air pollution, both ambient and household, increases the risk of cardiovascular and respiratory disease with above seven million deaths worldwide. For instance, at Sub-Saharan Africa and most of Asia and Oceania (excluding Australia/New Zealand) high mortality rates are caused by air pollution, where a meaningful proportion of the population employ polluting fuels and technologies for cooking. Inadequate health situations are generally linked to unsafe drinking water, sanitation and hygiene. For instance, 60 percent of the disease occurrences from diarrhea, 100 percent of infections from soil-transmitted helminths, and 16 percent of the burden from protein-energy malnutrition. Overall statistics point to a total of 870,000 deaths in 2016, from the above conditions [4]. These alarming figures point to strong AmI efforts to minimize the occurrence of these diseases, with technology and international cooperation issues.

SDGs 4 and 5 are related to quality education and gender equality, representing areas of key importance for sustainable development progress. The connection of AI devices with education and gender equality issues shall be indirectly related to the environment. The scope of this chapter is focused on primary connections among AmI technologies and the SDGs. Therefore, no further mention about their targets is made in the scope of this study.

SDG 6 relates to clean water and sanitation. It presents a complement to SDG 3, in particular, on water pollution and contaminants, expressing the interconnection among the SDGs. Most of its targets call for clean water and sanitation for the entire global population. AmI devices play a fundamental role in monitoring water quality and wastewater sanitation. For example, Target 6.3 is about reducing the water pollution, the elimination of dumping and minimization of hazardous chemicals releases, avoiding the increase of untreated wastewater at the same time the water recycling and reuse should be globally increased. The indicators for achieving this target are: proportion of wastewater safely treated and proportion of bodies of water with good ambient water quality. This target is probably among

the most connected to AmI in the entire SDGs group of targets. Next, Target 6.4 is about water-use and fresh water supply efficiency aiming at reducing the number of people suffering from water scarcity. The indicators are change in water-use efficiency over time and the level of water stress: freshwater withdrawal as a proportion of available freshwater resources. These are technical issues related to water usage efficiency, with relevant technology from AmI devices and data systems.

SDG 7 is related to affordable and clean energy. Targets 7.1, 7.2 and 7.3 mention, by 2030, the availability of universal access to affordable, reliable and modern energy services, the growth of renewable energy share in the total final energy consumption, and doubling the global rate of improvement in energy efficiency. It is fairly possible to envision a positive contribution of AmI systems related to home improvement, with energy savings measures from smart consumption practices, increasingly from non-fossil sources, such as solar energy using retrofit and collective exchanges (smart collective grids). These technologies may increasingly use Blockchain platforms to ensure safe consumption registers among all users (affordable energy). Smart grids, combined with energy sources and exchanges, such as solar power generation controls and other devices are becoming more present in modern buildings and houses. The Covid 19 pandemic has boomed the adoption of home office work, hence the need for further attention to energy management and savings. Additionally, the rise of cryptocurrencies has provided the tokenization and other non-fiduciary ways of monetizing energy trades and a safe accounting for the exchanges and information controls among users [5].

SDG 9, related to industry, innovation and infrastructure presents many links to AmI. For instance, target 9a is about the facilitation of sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries, and small island developing States. Target 9b is about the support of domestic technology development, research and innovation in developing countries, including the enforcement of a conducive environment policy for industrial diversification and value addition to commodities. The indicators are about the proportion of medium and high-tech industry value added in total value added. Target 9c aims at significantly increasing the access to information and communications technology, and strive to provide universal and affordable access to the Internet in least developed countries by 2020. The indicators are about the proportion of population covered by a mobile network and related technology. Notice the target date to be 2020, hence, already late in this achievement.

Additionally, target 9.4 calls for an upgrade and retrofit of industries with better resources' efficiency, improved technologies and processes, with more environmentally and clean solutions, according to each country capability level. The indicators are about CO2 emission per unit of value added. Next, Target 9.5 is dedicated to scientific research, technological upgrades of industrial sectors, particularly in developing countries, with the increase of personnel dedicated to research and development; and the growth of private and public research spending. The indicators are about research and development expenditure as a proportion of GDP.

SDG 10 relates to the reduction of inequality among and within countries. From an AmI perspective, it presents possible indirect connections to technologies for social and economic growth. Albeit it brings central issues to mankind, within the scope of this chapter, they are only indirectly related to AmI.

SDG 11, related to sustainable cities and communities, presents relevant interdependence with other SDGs and related AmI technologies. For example, Target 11.1 is about the access to adequate, safe and affordable housing for all, and the universalization of basic housing services and the upgrade of slums. This target is clearly connected to SDG 1 targets related to the availability and safety of housing, where

AmI plays a role in energy efficiency. Following, Targets 11.2 and 11.5 calls for a meaningful reduction of deaths and injuries from road disasters, water-related, and other disasters, with a focus on protecting the poor and people in vulnerable situations. The indicators are about the number of deaths, missing persons and persons affected by disasters and direct disaster economic loss in relation to global GDP. The indicator also includes the account of disasters´ damage to critical infrastructure and disruption of basic services. Target 11.6 is about the reduction of environmental impacts in cities, with special attention to air quality and municipal waste management. This Target is directly linked to AmI technologies. The indicators are clear about the ambient improvement, likely stated in the proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities; and annual mean levels of fine particulate matter (e.g. PM 2.5 and PM10) in cities (population weighted).

SDG 11 also presents other targets related to public policies about green areas and sustainable cities, indirectly benefited by AmI technologies. These targets also mention the areas air pollution and waste water, part of SDGs 3 and 6, being central for AmI technologies. Lastly, a mention is made to Target 11c, already due by 2020, that calls for a substantial increase in the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters. The indicators are related to public improvements in disaster preparedness, increasingly observed in the recent years of climate change observation, thus connected to SDG 13.

SDG 12, related to responsible production and consumption, presents relevant issues related to AmI. Target 12.2 states overall ambitions for a clean environment, as it calls for the achievement of sustainable management and efficient use of natural resources, in this case, related to clean production, with indicators enhancing local production and consumption. Next, Target 12.3 calls for the end of global food waste at the retail and consumer levels, and the reduction of food losses along production and supply chains, including post-harvest losses, with indicators of food loss index. In such cases, sustainable agriculture, industry, and retail practices are challenged to improve their food efficiency, being AmI monitoring and data management part of the solutions for this implementation. This target clearly relates to SDG 2 about food security, sustainable agriculture, hence being common targets between these two SDGs. Following, Target 12.4 calls, already by 2020, for the achievement of an environmentally sound management of chemicals and all wastes throughout their life cycle. These practices should be in accordance with agreed international frameworks, and have a significant reduction of their release to air, water and soil, in order to minimize their adverse impacts on human health and the environment. The indicators clearly point to AmI solutions, as an achievement of improved multilateral environmental agreements on hazardous waste, and other chemicals, with commitments and obligations in transmitting information as required by each relevant agreement. An additional indicator is about the volume of hazardous waste generated per capita and proportion of treated hazardous waste volume. Target 12.5 adds to the former, calling for a substantial reduction of waste generation through prevention, reduction, recycling and reuse, with indicators about the volume recycled materials. Clearly, good waste management practices are supported by AmI technologies.

The remaining SDG 12 targets are more related to public policies. A special mention, however, is made about targets 12.7 and 12.8 that call for the promotion of public procurement practices that are sustainable, in accordance with national policies and priorities, and ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with

nature. The indicators are about the number of countries implementing sustainable public procurement policies and action plans. A special mention is made for this target, because it suggests an overall effort of all nations to implement clean production and consumption policies and extension to global citizenship education, including the education for sustainable development with emphasis on climate change. As mentioned before, within the SDGs goals, many targets are related to public policies and international cooperation. These specific targets may represent the most far reaching concerns for sustainable development practices to be adopted. In this sense, research and development programs and incentives are a key part for SDG 12 to be successful by 2030. AmI development must be clearly part of this effort.

SDG 13 relates to climate action, a key goal for the entire global sustainable development. Climate change is widely perceived as the greatest threat to sustainable development of the 21st century. The monitoring and mitigation of GreenHouse Gases[1] (GHGs) emissions have multiple links with AmI, in areas of weather data predictions, disasters' avoidance, as well as information tools for positive climate actions, regarding the accounting of carbon footprints, carbon accounts and trading, and other GHGs accounting.

The international cooperation efforts for climate action has more than 25 years of activities, led by the UN Conferences of the Parties (COPs). As openly noticed, the diplomatic efforts among nations to negotiate world climate agreements have not been successful in providing the necessary progress to stop growing annual temperatures, substantially correlated to the increase in particulate matters per million (PPMs), with observed consequences of melting ice caps, rising sea levels, among many others.

SDG 13 is aimed at bringing more efforts on the global concern to stop climate change in the Earth. The adaptation to weather impacts by countries and economic sectors, and the mitigation measures required to reduce and stop global warming are the key issues in the climate change agenda. The transition of fossil based energies to low-carbon economies presents multiple implications for economic and social development, production and consumption patterns, and labor, in general.

SDG 13, beyond its sole importance, presents a high interdependence and connectivity with other SDGs. The targets call for integrated global and regional actions, bringing most of the other SDGs to the solutions.

Target 13.1 is about enhancing human resilience to face the growing number of natural disasters, certainly related to SDG 11, about sustainable cities, among other goals. Indicators are about the number of countries adopting natural disasters risk reduction strategies, and others. Such efforts shall have the input of AmI for weather and atmosphere monitoring. For instance, researches show that birds may be able to anticipate the severity of the hurricane season ahead, months in advance [6]. Relevant studies about the timing of bird migration habits in anticipation of the hurricanes season in North America shows relevant connections between animal species intelligence and the right time of a storm approach. Targets 13.2 and 13.3 mention the integration of climate change measures into national policies, strategies and planning, and the improvement of education, awareness-raising, human, and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning on the forecast impacts of climate change.

AmI, coupled with IoT and Artificial Intelligence present relevant issues in carbon measurement and pollution. Technologies related to machine learning can be a powerful tool in reducing GHG emissions. The areas of energy smart grids

[1] The primary greenhouse gases in Earth's atmosphere are water vapor (H2O), carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and ozone (O3)

present many controls related do AmI, with connections to energy savings and redistribution. Disaster management systems, through AmI devices, can identify extreme weather impact problems with collaboration of machine learning features, in collaboration with other fields. Further research is fully recommended in these areas, which, as well, presents promising non fossil business opportunities [7].

The following targets in SDG 13 call for finance and international cooperation for humanity to face global warming. A special mention is made to forest and agriculture GHG emissions and management, being such subjects relevant to other SDGs, such as SDG 2, for sustainable agriculture practices, and SDG 15, for natural resources management. Presently, most economic policies do not place attention on clean and low carbon rural production practices. Most of the prevailing agriculture practices have been releasing more carbon to the atmosphere than in the past decades, with new crop areas coming from deforestation and unsustainable agricultural practices. On top of these effects, cattle and rice farming generate methane, a GHG with high Global Warming Potential (GWP). Overall, land use by humans is estimated, by many sources, to be responsible for about a quarter of global GHG emissions. In addition, it is widely observable the effect of permafrost melt, peat bogs dryness, and the increase of forest fires, becoming more frequent as a consequence of climate change itself, thus, all of which, releasing more carbon to the atmosphere [8]. The large scale of this problem allows for a similar scale of positive impact. Reductions could come from better land management and agriculture. AmI can help data monitoring in areas of precision agriculture to reduce carbon and methane releases from the soil and livestock, improving crop yields with low GHG emissions, without the need for deforestation. Satellite images make it possible to estimate the amount of carbon sequestered in a given area of land, as well as track GHG emissions from it. Machine learning, coupled with AmI, can help the monitoring of standing forests and peatlands, and predict the risk of fires, hence contributing to sustainable forestry practices [9]. These are also applicable issues to SDG 15, enhancing the interdependence of SDG 13 with all other SDGs.

Other relevant climate change issues taking place worldwide are the concerted implementation of carbon trading platforms allowing a safe and true register of carbon emissions and trade among citizens, business and governments, in line with a commodity trade market. The Paris Agreement at COP 21 in December 2015, set the path to promising efforts to climate change action, mainly in allowing the development of carbon markets based on reduction and carbon neutralization mechanisms, requiring the development of market and accounting standards, supported by trustable electronic bases. The technology under these trading platforms are under development using Blockchain based networks to assure a safe register of any carbon asset to be traded and stored, being it a financial asset, or only a right of ownership. This framework of programs and electronic rules will receive inputs from Spatial Web and Web 3.0 programming [10], providing possible connections to AmI controls for further assurances. These actions are taking place through international voluntary cooperation among programmers, traders, systems developers, and carbon trading professionals. The expected results are the creation of a reliable platform to account and record all voluntary carbon trading transactions, worldwide [11]. The voluntary carbon markets are expected to double in size in the upcoming years, with an exponential growth in ten years. AmI technologies shall be a relevant contributor to the checks and balances within these sophisticated and open systems to come.

SDG 14, related to life below water, presents good connections with AmI, such is the case of Target 14.1, about prevention and reduction of all kinds of marine pollution, in particular from land-based activities, including marine debris and nutrient pollution, with indicators about an index of coastal eutrophication and floating

plastic debris density. Target 14.3 calls for the minimization of ocean acidification, calling nations to address such impact, including scientific cooperation at all levels. Target 14.4 refers, already by 2020, to an effective regulation of overfishing, with issues on illegal, unreported and unregulated fishing, and destructive fishing practices. The target also mentions the urgent implementation of science-based management plans to restore fish stocks, respecting the levels of maximum sustainable yield per species, as determined by their biological characteristics. Target 14.a is aimed at increasing scientific knowledge, developing research capacity, and transferring marine technology among nations. These actions must take into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology. Such issues are aligned to improve ocean health and to enhance the contribution of marine biodiversity, for nations to improve their sea management and fishing practices, with special attention to small island developing States and least developed countries. The other targets in SDG 14 are about the regulations, funding and international cooperation for sustainable oceans and responsible fisheries. In all technical aspects within ocean acidification and fishing management, AmI must add relevant information for water and acidification, and eutrophication measures, among other issues.

Finally, SDG 14 has close connections with SDG 6, about water and sanitation, and SDG 13, related to climate change, once more, enhancing the interdependence among sustainable development issues (**Figure 2**).

SDG 15, related to life on land, is of major significance for the global environment and climate, as well as for populations and the economy. It presents a high interdependence among SDGs related to hunger, health, education, water, economy, inequalities, sustainable cities, climate change and life on water. The world

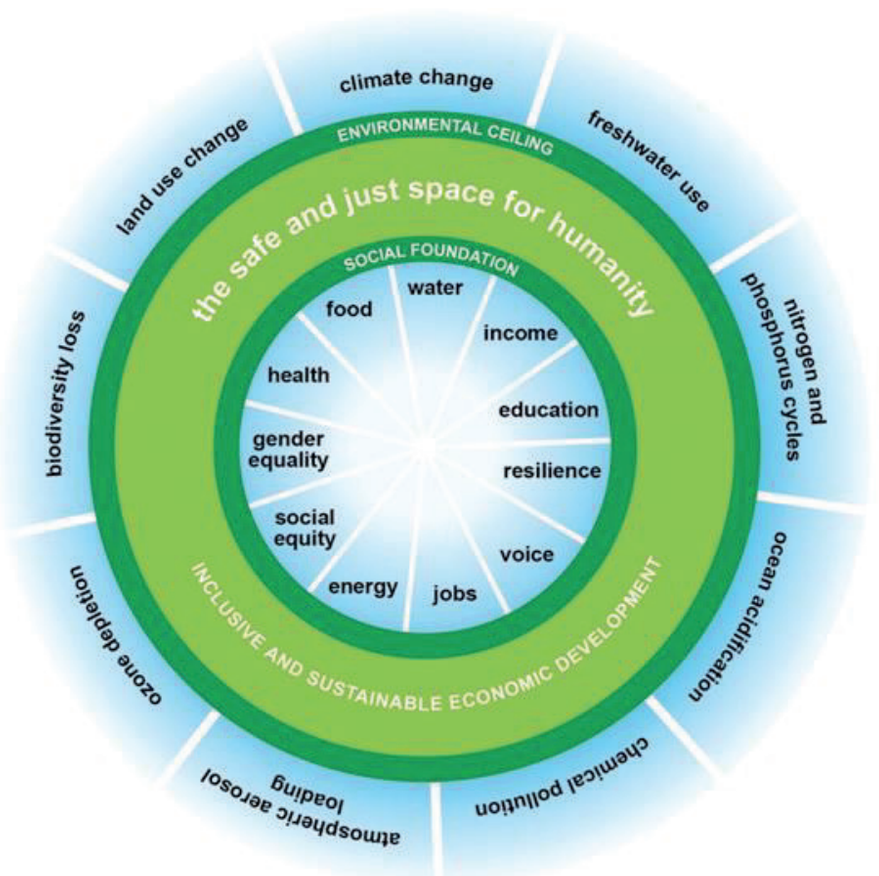

Figure 2
Sustainable development interdependence. Source: https://www.fdsd.org/the-challenge/what-is-sustainable-development/.

depends on standing forests and the other biomes with high ecological value to support most of the other SDGs. Target 15.1 calls, already in 2020, for the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands. Since this target should be already in place, it means that the world should not have more deforestation at present times. The reality however, is that between 2015 and 2020, the rate of global deforestation was estimated at 10 million hectares per year, down from 16 million hectares per year in the 1990s. The area of primary forest coverage worldwide has decreased by over 80 million hectares since 1990. Deforestation and forest degradation continue to take place at alarming rates, which contributes significantly to the ongoing loss of biodiversity [12].

AmI must play an important role in imagery and biodiversity monitoring. The indicators are clear: forest area as a proportion of total land area, and proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type. Target 15.2 complements the former, where it calls, also by 2020, for the implementation of sustainable management of all types of forests, the end of deforestation, the restoration of degraded forests, and for the substantial global growth of afforestation and reforestation. The indicators point to a progress in forest management. Such is the case for AmI technologies to support standing forests, mainly in the imagery, disaster preparedness and biodiversity issues.

The remaining targets in SDG 15 are related to desert, rivers and mountains conservation and restoration. Also, they call for equitative sharing of benefits arising from the utilization of genetic resources, actions against illegal trade and traffic of natural species. Target 15.8, for instance, calls for the introduction of measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species. The monitoring and safe register of genetic resources and control of invasive species presents important challenges to be met with AmI technologies, for example, with the use of banks of codes, supported by safe registers under Blockchain platforms and environmental databases showing constant update and progress analyzes. Finally, the areas of sustainable soil management, forest conservation, ecosystem services and all natural resources offer multiple uses for data, image, and monitoring management, based on AmI.

SDG 16 is related to peace, justice and strong institutions, with issues related to human rights, such as the assurance of citizenship, equality; to end corruption, end violence and promote equality among all. It is closely related to SDGs 1, 5 and 10, for instance, with focus on social issues. For this chapter overview of AmI relationships with the SDGs, the targets in this SDG are of a non-AI nature, therefore no further comments are provided here, albeit their fundamental importance for the global sustainable development goals.

The closing SDG 17, related to partnerships for the goals, has five groups of targets: (1) providing finance to the SDGs, (2) technology transfers and funding, (3) training issues, (4) trade issues, and (5) systemic issues related to international cooperation, partnerships and safeguards to the SDGs to be implemented. A special mention is made to the technology targets, providing connections with AmI. For instance, Target 17.6 calls for the international cooperation in all kinds and forms: North–South, South–South and triangular cooperation; regional and international cooperation. Also it calls for the access to science, technology and innovation, and an enhanced knowledge sharing on mutually agreed terms, among nations, with improved coordination by the United Nations, for example. The indicators point to the number of science and/or technology cooperation agreements and programmes between countries, by type of cooperation, and internet coverage for all globe

inhabitants. Next, Target 17.7, calls nations to fully operationalize technology banks and science, innovation, and capacity-building mechanism for least developed countries, already past due, by 2017. The main indicator of achievement is also the internet coverage for all world inhabitants. Such targets call for an intense global cooperation with focus on technology transfers among developed, less developed, and poor nations. The issues of AmI are all part of these targets, given their high technology nature.

4. Conclusion

The SDGs are unmistakably the most complete and overall framework of collective objectives for humanity to preserve and improve planetary life quality. The proposed actions, stated as "targets", refer to technical and policy oriented tasks. Most of the objectives depend on integrated public policies and international cooperation among nations, institutions and society in general. They represent an intense and present effort towards a global solution for a healthy planet, so far, not achieved by past endeavors.

The SDGs represent the outcome of historic global efforts towards a sustainable world. From a diplomatic standpoint, the first concerns for sustainability were raised in the Brundtland Report, about our Common Future, at the Stockholm Conference, in 1972 [13]. Following, international events took place during the 70's and 80's, but the benchmark for global environment policies was set at the United Nations Conference on Environment and Development (UNCED), called "Earth Summit Conference" held at Rio de Janeiro, Brazil (June 3–14, 1992), that brought high attention to global economic development and environment issues [14]. This meeting created the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity; a declaration on the principles of forest management conventions for the climate and biodiversity; and the Agenda 21. These conventions and efforts gave birth to intense diplomatic, government and civilian actions towards sustainable development. Nevertheless, most of the advances made, globally and locally, have failed short of the projected objectives, being climate change, the most relevant global issue, concerning the future of the planet.

In the same period that the environment awareness has risen to high concerns, all "human living" issues have equally risen to a high level of attention, such as poverty, hunger, health, education, inequality and racial issues, presently enhanced by the global Covid 19 pandemic. For these reasons, the SDGs were conceived. They were framed into a logical thought of total integration and interdependence of human and nature concerns. No development in human life quality is possible without a healthy and sustainable environment. In this sense the role of Ambient Intelligence technology is key for an efficient environment control, providing the basis for life quality policies to be successful.

The SDGs cover all aspects of human and environmental issues for a sustainable future. In this chapter, a study was made in attention to the various subjects related to natural resources, agriculture, water and sanitation, energy, clean production, urban life, climate change, life below water, forests and all "human" related issues, as key for humanity to continue its path to a better future. Such legacy is implicit in the sustainable development concept, and shall be vigorously pursued by Ambient Intelligence technologies to help the achievement of all targets outlined for sustainable development. In this endeavor, governments, academia, and industries, shall team vigorously to seek extraordinary results in research and development, technology transfers, with attention on the cost and accessibility of these inventions.

The Ambient Intelligence community, should pursue a concerted effort to spread, teach, exchange and foster all kinds of knowledge associated with the SDGs through a careful attention to its targets, clearly expressed in the official UN SDGs guidelines. This study has tentatively selected a meaningful piece of information for AmI professionals and institutions to exchange and explore present technologies and research possibilities in line with the SDGs.

This chapter had the proposal of introducing the key aspects of the SDGs presenting technical and institutional connections with the Ambient Intelligence devices and community. It is feasible to believe that by 2030, when the SDGS are targeted to be in place, Ambient Intelligence will be more present in life and environment checks and controls. Such is the overall legacy of this chapter: a proposition of a growing awareness of Ambient Intelligence devices and institutions, further stimulated to adopt the SDGs as part of their strategies for a sustainable world in 2030. This is an achievable role that can be of relevant importance for the Ambient Intelligence community to prosper and leave a better world for the next generation to come, with strong concern and education for sustainable development, strongly aided by Ambient Intelligence devices and public policies, worldwide.

Author details

Luiz Cruz Villares
Fundação Amazônia Sustentável (Sustainable Amazon Foundation), Manaus, Brazil

*Address all correspondence to: luiz.villares@fas-amazonas.org

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