# HEALTH AND ENVIRONMENT RANKING: A STUDY OF THE COUNTRIES AT THE IBEROAMERICAN REGION AND ITS CHALLENGES AHEAD

*Condições de saúde e meio ambiente: Um ranking dos países da região iberoamericana e seus desafios para frente*

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**Abstract:** This is an exploratory study of Health and Environment conditions concerning 132 countries in the world, that lead to produce a ranking among 21 Iberoamerican countries, based on World Bank Data (2015) and the guide for sustainable planning – GPS prepared by the Future Studies Center of PUC-SP (Pontifical Catholic University of São Paulo) for the Observatory of the Iberoamerican Region - ORIBER. Through a mixture of Multivariate Statistical Analysis techniques this work came to a list of 10 most representative variables of Health and Environment development of the Latin American Region that help to build a rank and classified the region into levels of development, that may help for strategic planning, monitoring and control at a country and regional base.
**Key words:** Health; Environment; Iberoamerica.

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**Resumo:**Trata-se de um estudo exploratório das condições de saúde e meio ambiente de 132 países do mundo, que ajudam a compor um ranking que permite comparar 21 países ibero-americanos, com base em dados do Banco Mundial e o guia de Gestão Publica Sustentável - GPS preparado desenvolvido pelo Centro de Estudos do Futuro da PUC-SP (Pontifícia Universidade Católica de São Paulo) para o Observatório da Região Ibero-americana - ORIBER. Utilizando técnicas de Análise Multivariada foram selecionadas 10 variáveis mais representativas do desenvolvimento da Saúde e o Meio Ambiente da Região da América Latina que ajudam a construir o ranking e classificat a região em níveis de desenvolvimento, que podem ajudar no planejamento estratégico, monitoramento e controle em um país e base regional.
**Palavras-Chave:** Saúde, Meio Ambiente, Iberoamerica

## INTRODUCTION

Improvements on the quality of environmental and health policies can make a big difference in the quality of life of the population anywhere. Food, water and energy are basic resources related to health and environment that need to be maintained and well administered in the search for a sustainable development. Iberoamerican countries have different economies, resources, infrastructure, governance, and a number of other factors that influence economic growth, causing inequality between people and disharmony opportunities. Some are more rural, poorer, more unequal internally, others deal with a share of more concentrated workers in urban areas, with a more bourgeois population, that control the means of production, but dealing with so many problems that reverberate in poor health and a lack of protected environment. In other words, the difference between the countries with regard to health and the environment calls for an adequate customization of the application of administrative and financial resources applied. It is important to say that, although Latin American region may have improved over time, there is still a long way in pursuit of sustainable development for which is the main concern of this study.

The concepts behind the theme Health and Environment were taken from the World Bank (2015) and the guide for sustainable planning – GPS prepared by the Future Studies Center of PUC-SP (Pontifical Catholic University of São Paulo) for the Observatory of the Iberoamerican Region – ORIBER. The last one is a document about the Sustainable Public Management. According to the GPS (2016), one of the big challenges facing today for the Ibero-American region is to identify how to balance the necessary economic dynamics to environmental sustainability and social balance in the context of an open, democratic and participative management.

One way to contribute to overcome to this challenge is to promote in each country, through the planning offices, synergies between the scientific, technological, socio-cultural and institutional sectors: such synergies should harmonize the processes and impacts of development in each country and region, making them sustainable, encouraging citizen participation as a contribution to improve the quality of life, and enjoying effectively the exchange of information and exchange of information and experiences with other countries in the Latin American region (GPS. 2016).

The economic, social and environmental imbalances in the Iberoamerican Region motivated the search for responses from the international community, and lead to the proposal of the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals (ODS) including 193 countries represented at the United Nations General Assembly adopted in September 2015. These commitments recognize equality and sustainability as the guiding, shared and universal principles on which to base a new set of strategies and global regional and national policies (CEPAL. 2015).

Before the presentation of the subjects of this analysis and data involving the countries, it's important to present the framework behind.

## THE THEORETICAL FRAMEWORK

According to the GPS - Guide to Sustainable Countries (2015), the Latin American and Caribbean countries suffer from a large gap between the theoretical knowledge of environmental health and its practice in public policy. Access and benefits to the population are affected. This contrasts with the richness of these regions in biodiversity, yet extremely threatened. Most of the population is concentrated in urban centers, live in precarious conditions and its development model is historically linked to the predatory extraction of natural resources and exploitation of the land due to large monocultures for export, primarily to the colonies. This process today is called neocolonialism extraction (CEPAL, 2015).

Unfortunately, the destruction of the environment has often been much higher than should be acceptable for the survival of the human species. According to CEPAL (2015), nowadays, it shows two singularities. One of them is that the impact is not only local but affects common resources: the atmosphere, oceans, ice caps and biodiversity. The second is that, for the first time, there is a conscious and informed generation, from scientific evidence of this impact and the risk that human activities pose to the environment.

Changes in climate variables such as temperature and rainfall, have impacts on: reduced yields of subsistence crops such as potatoes and corn in Central America and the Andean countries; reduction

in grazing areas, with effects on livestock productivity in Argentina and Paraguay; increased incidence of dengue and malaria in most countries; modification of plant and animal biodiversity, increasing desertification and deforestation; involvement of the hydropower sector of most countries in the Andean Region (Argentina, Bolivia, Chile and Peru) by reduced flows and increased sedimentation, and impact on tourism and infrastructure by high impact events (hurricanes and El Niño / Southern Oscillation) (CEPAL, 2015a, 2014b, 2014c; BID/CEPAL, 2014a, 2014b y DNP/CEPAL/BID, 2014).

As a recent IPCC report (2013) reiterates warming of the climate system is unequivocal (ex. storms in the Rio de La Plata, which have caused severe flooding, and the waves in the Mexican Pacific, as well as in Argentina and Uruguay). It is expected that extreme flood events are becoming more frequent and affect urban areas of the east coasts of the Caribbean and South America, mainly Brazil (CEPAL, 2012b) at the same time droughts are becoming more critical.

According World Health Organization (2015), the variables below traduce some of the Health and Environment problems to confront with:

• Maternal mortality rate (deaths/100,000 live births): The annual number of female deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 live births.

• Stillbirth rate (deaths/1,000 live births): Third trimester fetal deaths (> 1000 grams or > 28 weeks), per 1,000 live births.

• Child mortality rate (deaths/1,000 live births): The probability of a child born in a specific year dying before reaching the age of five per 1,000 live births.

• Deaths from infectious diseases (deaths/100,000): Age-standardized mortality rate from deaths caused by tuberculosis, sexually transmitted diseases, HIV/AIDS, diarrhea, pertussis, polio, measles, tetanus, meningitis, hepatitis B, hepatitis C, malaria, trypanosomiasis, Chagas disease, schistosomiasis, leishmaniasis, lymphatic filariasis, onchocerciasis, leprosy, dengue, Japanese encephalitis, trachoma, intestinal infections, and other infectious diseases per 100,000 people.

• Access to piped water (% of pop.): The percentage of the population with a water service pipe connected with in-house plumbing to one or more taps or a piped water connection to a tap placed in the yard or plot outside the house (World Health Organization/UNICEF Joint Monitoring Programme, 2015).

• Access to improved sanitation facilities (% of pop.): The percentage of the population with improved sanitation, including flush toilets, piped sewer systems, septic tanks, flush/pour flush to pit latrine, ventilated improved pit latrines (VIP), pit latrine with slab, and composting toilets (WHO/ UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2015).

• Indoor air pollution attributable deaths (deaths/100,000): Age standardized deaths caused from indoor air pollution, including indoor air pollution-derived cases of influenza, pneumococcal pneumonia, H influenza type B pneumonia, respiratory syncytial virus pneumonia, other lower respiratory infections, trachea, bronchus, and lung cancers, ischemic heart disease, ischemic stroke, hemorrhagic and other non-ischemic stroke, chronic obstructive pulmonary disease, and cataracts per 100,000 people. In the SPI model, data is scaled from 3 (<30 deaths per 100,000 people) to 1 (>100 deaths per 100,000 people).

• Life expectancy (years): The number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.

• Non-communicable disease deaths (between the ages of 30 and 70 – probability of dying): The probability of dying between the ages 30 and 70 from cardiovascular disease, cancer, diabetes, or chronic respiratory disease.

• Obesity rate (% of pop.): The percentage of the population with a body mass index (BMI) of 30 kg/m2 or higher (age-standardized estimate), both sexes.

• Outdoor air pollution attributable deaths (deaths/100,000): The number of deaths resulting from emissions from industrial activity, households, cars and trucks, expressed as the rate per 100,000 people.

• Health expenditure, public (% of total health expenditure) 2012: Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external

borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. Total health expenditure is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.

• External resources for health (% of total expenditure on health) 2012: they are funds or services in kind that are provided by entities not part of the country in question. The resources may come from international organizations, other countries through bilateral arrangements, or foreign nongovernmental organizations. These resources are part of total health expenditures.

• The Human Development Index (HDI) measures the progress of a nation from three dimensions: income, health and education United Nations Development Programme http://www.pnud.org.br/atlas/ranking/Ranking-IDH-Global-2013.aspx

• The Government Effectiveness (Governance): consists of the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them. The Worldwide Governance Indicators report on six broad dimensions of governance for 215 countries over the period 1996-2013: Voice and Accountability, Political Stability, Regulatory Quality, Rule of Law and Control of Corruption.

• The Environmental Performance Index (EPI): ranks how well countries perform on

high-priority environmental issues in two broad policy areas: protection of human health from environmental harm and protection of ecosystems. http://epi.yale.edu/epi

• Happy Planet Index 2012 (HPI): is the leading global measure of sustainable well-being.

The HPI measures what matters: the extent to which countries deliver long, happy, sustainable lives for the people that live in them. The Index uses global data on life expectancy, experienced well-being and Ecological Footprint to calculate this. The index is an efficiency measure, it ranks countries on how many long and happy lives they produce per unit of environmental input. The 2012 HPI report ranks 151 countries and is the third time the index has been published (ABDALLAH, 2012).

• Ocean Health Index Score (OHI): The Ocean Health Index establishes reference points for achieving ten widely accepted socio-ecological objectives, and scores the oceans adjacent to 171 countries and territories on how successfully they deliver these goals. Evaluated globally and by country, these ten public goals represent the wide range of benefits that a healthy ocean can provide; each country's overall score is the average of its respective goal scores: Food Provision( harvesting seafood sustainably), Artisanal Fishing Opportunities(ensuring food for local communities), Natural Products(harvesting non-food ocean resources sustainably), Carbon Storage(preserving habitats that absorb carbon), Coastal Protection(preserving habitats that safeguard shores), Coastal Livelihoods & Economies(sustaining jobs and thriving coastal economies), Tourism & Recreation(maintaining the attraction of coastal destinations), Sense of Place (protecting iconic species and special places), Clean Waters(minimizing pollution), Biodiversity(supporting healthy).

• GINI index (World Bank estimate): measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

• Social Progress Index (SPI): measures a complex mix of Basic Human Needs, Foundations of Wellbeing and Opportunity; and "(...) depends on the policy choices, investments, and implementation capabilities of multiple stakeholders – government, civil society, and business" (Michael Porter, http://www.socialprogressimperative.org/global-index/, 2016).

Due to these all aspects, to deepen the understanding of the data of the variables that make up these issues can help in confronting and overcoming the challenges through which they pass the region.

**PRESENTATION AND ANALYSIS OF RESULTS**

For the purpose of analyzing how the Iberoamerican Region as a whole is doing regarding Health and Welfare, the present study compares three Regions among a total of 132 countries: The Iberoamerican Region (AIBER) with 21 countries, an Advance Economies Region (AVECO) with 27 countries and the rest of other countries (OTHERS) with 84 countries. The study begins with an exploratory descriptive data analysis to understand the 20 indicators influence the Health and Environment of such countries. For this comparison was used the ANOVAs, based on the Knoema statistical database.

**Individuals**

Individuals of this analysis are the 132 countries analyzed by a number of international benchmarks. The data analyzed in each country are the Twenty variables described below.

• Seven Synthetic Indicators: Social Progress Index, Human Development Index - HDI, Governance Index, Environmental Performance Index - EPI, Happy Planet Index (HPI), Health Index Of Oceans - IHO and Inequality Index social or Gini.

• Thirteen Analytic Indicators: Maternal Mortality Rate, Stillbirths Rate, Infant Mortality Rate, Deaths by Infectious Diseases, Access to Piped Water Access The improved sanitation facilities, Deaths Attributable to Air Pollution Indoors, Expectation Life (years) Deaths by No Communicable Diseases Between the Ages of 30 And 70 (Dying of probability) Obesity rate, Deaths Attributable to Air Pollution Exterior, Public Health expenditure, External Resources for Health.

The 21 countries of the Iberoamerican Region which are going to be considered are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Spain, Uruguay and Venezuela. Generally speaking, Spain and Portugal are always doing better regarding Health a Social wellbeing, so they may serve as examples for the rest.

Through a Dendogram, that is a specific type of diagram or iconic representation which organizes certain factors and variables based on its similarity or distance, below it is showed the clusters or groups by how correlated are the variables; and hence showing similar behavior
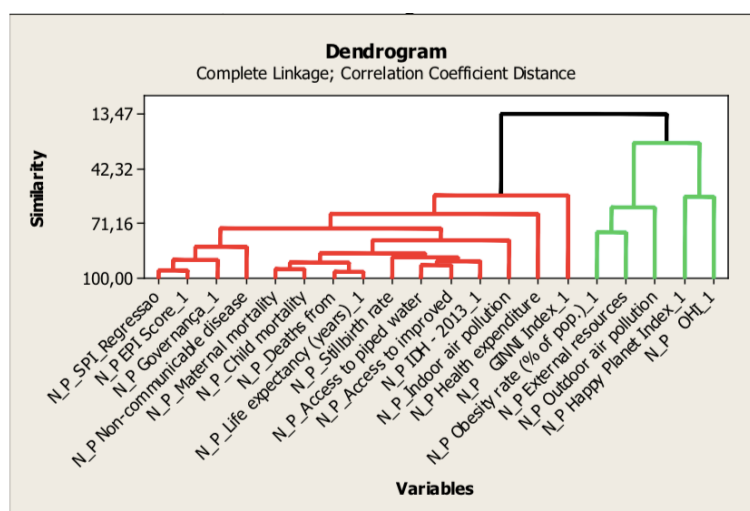


**Figure 1    Intercorrelations among the Variables**
Source: by authors, 2016.

This figure 1 shows particularly a high degree of behavior similarity among the variables: SPI, EPI, Governance, HDI, Maternal Mortality, Child Mortality, Deaths from Infectious Diseases, Life expectancy, Access to piped water, Access to improved water, Stillbirth rate, Indoor air pollution and Non-communicable disease; in another level of correlation and for another group of countries, there are the variables Health expenditure, HPI and Gini, , in another degree of similarity, there are: Obesity, External resources, Outdoor air pollution and OHI.

Moreover, SPI and HDI are very closely related, so for practical purposed one may simply use this last one that is simpler and have a longer data history, and actually both are basically dealing with Social Conditions.

A statistical analysis of 132 countries lead to the selection of ten variables (all rescaled from 0 to 100 and positivized - the higher the better) more representative of the Health and Environment conditions. They were: Deaths from Infectious Diseases, Access to piped water (% of pop), Obesity rate, Outdoor air pollution, HDI (0 – 100) Governance, EPI Score (0 – 100), Happy Planet (0 – 100), Ocean Health Index OHI (0 – 100), GINI (0 – 100).

Table 1 helps to understand similarities and differences between the 3 selected Regions. The higher the F the higher the difference among the 3 Regions; so that Governance (GOV) makes the higher difference (F = 97,02), and the AVECO Region has a much higher value (83,25), twice as more, than other two Regions. This could be seen very clearly in Graphic 2 that allows more easily to visualize differences and compare the regions observing where and how much do they differ each other in relation to each of these 10 dimensions.

**Table 1 ANOVA Comparing Means of the 3 Regions: AIBER, AVECO and OTHERS;**
**As Well as Fs for the Variables (All Variable were Normalized 0 - 100,**
**and Positivized: the Higher is the Best One)**

| | Deaths[2] | Access[3] | Obesity | Outdoor[4] | HDI | Governance | EPI | HPI | OHI | GINI |
|---|---|---|---|---|---|---|---|---|---|---|
| OTHER | 70,63 | 47,27 | 66,88 | 74,76 | 47,46 | 33,36 | 37,95 | 41,79 | 51,07 | 62,44 |
| AIBER | 92,89 | 85,22 | 46,68 | 82,09 | 65,62 | 42,48 | 52,70 | 72,36 | 55,45 | 43,08 |
| AVECO | 98,90 | 94,89 | 53,73 | 77,50 | 85,11 | 83,25 | 81,39 | 50,58 | 24,24 | 79,91 |
| F[1] | 19,03 | 37,63 | 9,5 | 1,32 | 34,45 | 97,02 | 69,68 | 22,69 | 29,45 | 24,45 |

Source: by authors, 2016.
Notes: [1]The higher the F distinguished from other regions; [2]Deaths from Infectious Diseases; [3]Access to piped water; [4]Outdoor air pollution

The Figure 2 shows that the AVECO's region has better conditions than the others in GINI, Access of Piped Water, EPI, Governance, and HDI. In Outdoor Air Pollution, Deaths from Infectious Diseases and Obesity, it is very close of AIBER's region. In Obesity AIBER and OTHERS regions have scores close. Related to Ocean Health Index Score (OHI), and Happy Planet Index, AIBER's region has better scores than AVECO's region. Related to OHI, AIBER's region and Others' region has scores close each other. In resume, the AVECO group is close to Governance and EPI and far from OHI. The AIBER, although closed to the Happy Planet, is far from Gini. And the OTHERS' group is close to Obesity and far from Access to Piped Water.
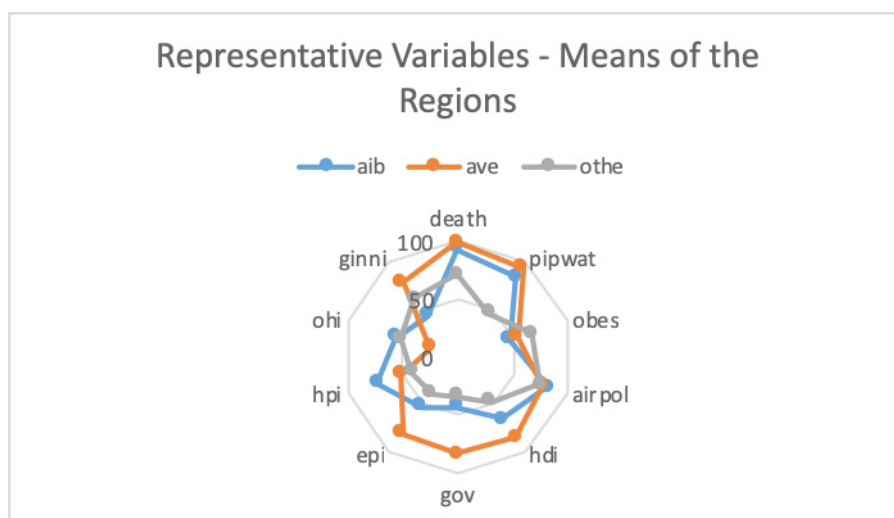


**Figure 2** Radar of Means of the Regions AIBER, AVECO and OTHERS
Source: by authors, 2016.

Now using the first three Principal Components (eigenvalues > 1,0) related to these 10 variables and considering the relative contributions of each one of these variables to these component by means of Stepwise Regressions one may build up a New Synthetic Indicator that we are calling HEN that clearly shows the general relative conditions and differences among the 3 Regions as shown by the ANOVA in figure 3.
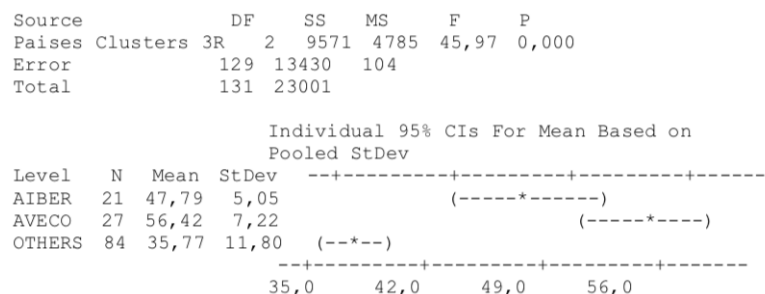
```
Source              DF    SS    MS     F     P
Paises Clusters 3R   2  9571  4785  45,97  0,000
Error              129 13430   104
Total              131 23001

                     Individual 95% CIs For Mean Based on
                     Pooled StDev
Level   N   Mean StDev  --+---------+---------+---------+-------
AIBER  21  47,79  5,05                  (-----*------)
AVECO  27  56,42  7,22                         (-----*----)
OTHERS 84  35,77 11,80  (--*--)
                     --+---------+---------+---------+-------
                     35,0     42,0     49,0     56,0
```

**Figure 3** One-Way ANOVA: HEN Versus 3 Regions

Moreover, this new HEN Health and Environment Synthetic Indicator; allows to us to define a normalized ranking (0 – 100) among the countries of the Iberoamerican Region as shown in Table 2 and somehow establish its present level of conditions in the area.

**Table 2 HEN Ranking**

| Iberoamerican Country | Ranking | Level |
|---|---|---|
| Spain | 100,00 | HIGH |
| Chile | 81,69 | HIGH |
| Costa Rica | 79,74 | HIGH |
| Cuba | 72,27 | MIDDLE |
| Argentina | 69,55 | MIDDLE |
| Panama | 68,71 | MIDDLE |
| Portugal | 67,23 | MIDDLE |
| Venezuela | 60,72 | MIDDLE |
| Uruguay | 56,63 | MIDDLE |
| Mexico | 52,40 | MIDDLE |
| Brazil | 48,87 | MIDDLE |
| Colombia | 43,38 | LOW |
| Peru | 43,38 | LOW |
| Ecuador | 38,45 | LOW |
| El Salvador | 24,94 | LOW |
| Dominican Republic | 22,38 | LOW |
| Bolivia | 14,14 | VERY LOW |
| Paraguay | 10,39 | VERY LOW |
| Guatemala | 6,95 | VERY LOW |
| Nicaragua | 2,67 | VERY LOW |
| Honduras | 0,00 | VERY LOW |

Source: by authors, 2016.

## CONCLUSIONS

Reflecting on the result of the statistical methods applied to the data, it is clear that most Latin American are still at a stage of low level of development and environmental protection and health, confirming the historical data, although the general situation is better than in OTHERS Countries, moreover as we can see by the ranking the worst conditions seem to be somewhat regional (LOW and VERY LOW).

As expected, environmental factors can be improved in general in Latin America. The infrastructure of public health available in each country should also be the focus of attention to resolve the predispositions to diseases.

A few points are worth mentioning. In Latin America, the GPS provided that Argentina, Chile and Uruguay were performing a little better in terms of Environmental Performance Index (EPI) for example, which remains true, although Argentina has dropped a bit on this scale. Brazil improved somewhat in the past few years, so that the HDI rises a little its level, but still very low. Moreover, what is becoming more evident everyday worldwide is that what makes the greatest difference is the Governance factor; and in this sense we still have a long way to go in at least in the Latinamerican Region, perhaps with a f ew exceptions of smaller countries like Chile, Uruguay, Costa Rica and Panama.

Therefore, what is expected is that all these data from the Observatory ORIBER will help the responsible public and private institutions that are involved in the monitoring and control of environmental and health risks in order to develop measures and campaigns to prevent impacts and promote the well-being of the population of Iberoamerican countries; but no doubt this will depend on how fast we advance regarding Governance, and to what extent we become more aware about the Environmental Impacts on our health.

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