CHAPTER 2

State and Trends

All of the GEO-6 regional assessments follow the traditional Drivers, Pressures, State, Impacts and Response (DPSIR) assessment framework; however, each integrated environmental assessment considers the elements of this framework in a regional context. For LAC drivers of environmental change include economic development, population growth, climate change, natural hazards, technological innovation, and governance frameworks. Unsustainable consumption and production, highlighted in the regional priorities, affect sectors such as energy, mining as well as both commercial and personal consumption.

This Chapter of the Regional Assessment considers these drivers and the pressures they exert on the environment by analysing the recent trends in the state of the environment as well as the impacts of this environmental change on human health, productive activities and ecosystems. The analysis is conducted according to four environmental themes, namely:

- Air, including common and toxic air pollutants as well as GHG emissions;
- Freshwater, including quantity and quality;
- Oceans, including pollution sources and commercial activities;
- Land, including fragmentation and degradation; and
- Biota, including both plant and animal biodiversity.

2.1 Air

2.1.1 Overview and main messages

The atmosphere is a thin and delicate layer that constitutes a key link between humans and ecosystems. Its role in biogeochemical cycles is vital in keeping planet Earth functioning within boundaries that enable life to exist in the way we know it. Anthropogenic air emissions are changing the natural composition of the atmosphere at unprecedented rates (UNDESA, UNEP and UNCTAD 2012) and might lead to local, regional and global impacts on health, environment, society and the economy (IPCC 2014).

Key Messages: Air

There have been sharp increases in concentrations of greenhouse gases in the atmosphere, surpassing planetary limits for climate change (Steffen *et al.* 2015). GHG emissions are growing rapidly in the region as a result of urbanization, economic growth, energy consumption and land use changes, among other chief factors (IPCC 2014).

According to the World Bank (2015), carbon dioxide emissions from the burning of fossil fuels and the manufacture of cement in LAC have increased in absolute terms, +14.18 per cent in the period 2006-2011, although their levels as a proportion of GDP (kg per PPP USD of GDP) have declined by 14.35 per cent in the same period. In 2005, the region's countries accounted for almost 10 per cent of global GHG emissions (EC 2016). More recent figures confirm such a level with 10.6 per cent reported in 2012 (EC 2016).

Urban growth has been described as a major pressure of air pollution in LAC, due mainly to increased energy consumption and transport. In the past decade there has been a dramatic increase in private car ownership in countries in the region with high GDP growth (UN-Habitat 2013). The countries with the biggest growth in the total number of cars between 2005 and 2008 are Mexico (8 543 807), Chile (768 874) and Peru (328 692). Suriname leads the list of countries with the highest number of cars per 100 habitants (30.3), followed by Mexico (27.8), Uruguay (21.7) and Chile (19.8) (UNECLAC 2015b).

◄ Credit: Shutterstock/ elnavegante

These changes result in degradation of the air in urban and rural areas, both indoors and outdoors, at local, regional and global scales. Far from clean air, many populated areas in LAC register deleterious concentrations of criteria pollutants, air toxics, Persistent Organic Pollutants (POPs), mercury and other harmful substances (**More...5**). Particulate Matter, PM10 and PM2.5, and ozone are major pollutants in urban areas, while soot constitutes to be a major health concern in rural areas.

The LAC region has made large progress on the reduction of ozone-depleting substances and the elimination of lead in gasoline, reducing significantly the impacts on the ozone layer and lead concentrations in air, in particular in urban settings. But new threats are appearing on the horizon such as the increase in particulate matter in almost all urban centres where there are monitoring records, and the complexity of chemicals released into the air having direct or indirect impacts on air quality but also on the climate.

Emerging issues include secondary pollutants formed in the atmosphere by reactions in the urban atmosphere. The reduction of emissions of greenhouse gases having long residence time in the atmosphere is also an important challenge. Toxic chemical emissions are also of concern. Overall, improving emission inventories is regarded as necessary to implement better policies at national and regional levels. Contaminants such as black carbon have received more attention during recent years and are now a priority because of their radiative forcing on the climate system.

Biomass burning is recognized as an important topic at the regional level, and the impacts are both in terms of air quality and releases of greenhouse gases; more attention should be paid on waste burning considering that new chemicals may be released from these practices which, very unfortunately, are still very common throughout the region.

As the region improves its economy, energy demand increases. Since fossil fuels are still an important source of energy for transport and industry, the increased energy consumption is producing a steady increase in carbon dioxide emissions. Reducing fossil fuel use, together with the widespread adoption of more efficient, energy-saving and cleaner technologies, are necessary in the region to achieve any significant reductions in emissions over the coming years.

Regional governance and policies on air quality are needed because pollution is a transboundary issue. Initiatives such as the Regional Action Plan on Atmospheric Pollution, mandated by the Forum of Ministers of Environment of LAC in 2014, are critical to coordinate this effort. However, a more holistic approach including urban planning, with enough green areas and connecting with ecosystems services reduction or fuel oil consumption, cleaner technologies, and the improvement of living conditions in impoverished areas, are needed to maximize environmental, social and economic co-benefits.

Moreover, the potential of the atmosphere to act both as a sink and a source of anthropogenic pollutants highlights the need to strengthen and disseminate knowledge to inform decision makers and engage stakeholders in increasing a comprehensive understanding of atmospheric issues and their relationship to human and ecosystem health. For this to happen there is a need to improve and coordinate the air quality monitoring networks to cover the entire region and produce enough data to inform the development of reliable policies for protecting human health and the environment.

2.1.2 Pressures

Major sources of air pollution in Latin America include transport, large-scale combustion, industry, residential and commercial combustion, fossil-fuel extraction and distribution, waste and landfills, and open burning of biomass.

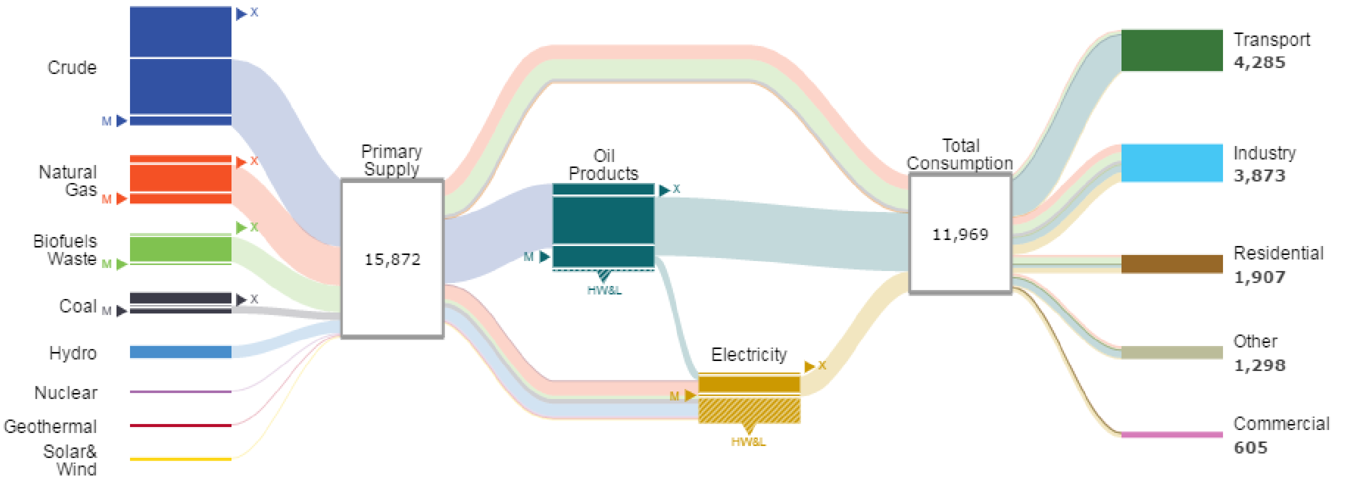
LAC's motorization rate is one of the highest in the world (OICA 2013). While public transport systems still have the largest share for the provision of collective transport, cars and motorcycles are rapidly taking over. Overall, this results in increased transport externalities including health and ecosystems impacts from increased air pollutant emissions, as well as traffic congestions and accidents.

The transport sector is the major cause of air pollution in LAC, both in terms of emissions (22 per cent of the regional total) and harmfulness (Timilsina and Shrestha 2009). In this context, it is important to note that in LAC vehicles are not the only cause of air pollution. Shipping is also an increasingly important source of air pollution and GHG emissions, mainly sulphur and nitrogen oxides, and particulates. It is estimated that 70 to 80 per cent of air toxics from ocean-going vessels are released within 400 kilometres of the shore, where they can have substantial effects on human health.

International shipping is a major source of diesel black carbon emissions, which are not yet subject to international regulation. Carbon dioxide emissions from international shipping more than doubled between 1990 and 2007 and the marine sector now generates about 2.7 per cent of global carbon dioxide emissions. Recent growth projections suggest it could account for 7 per cent of global emissions by 2050 (ICCT 2015).

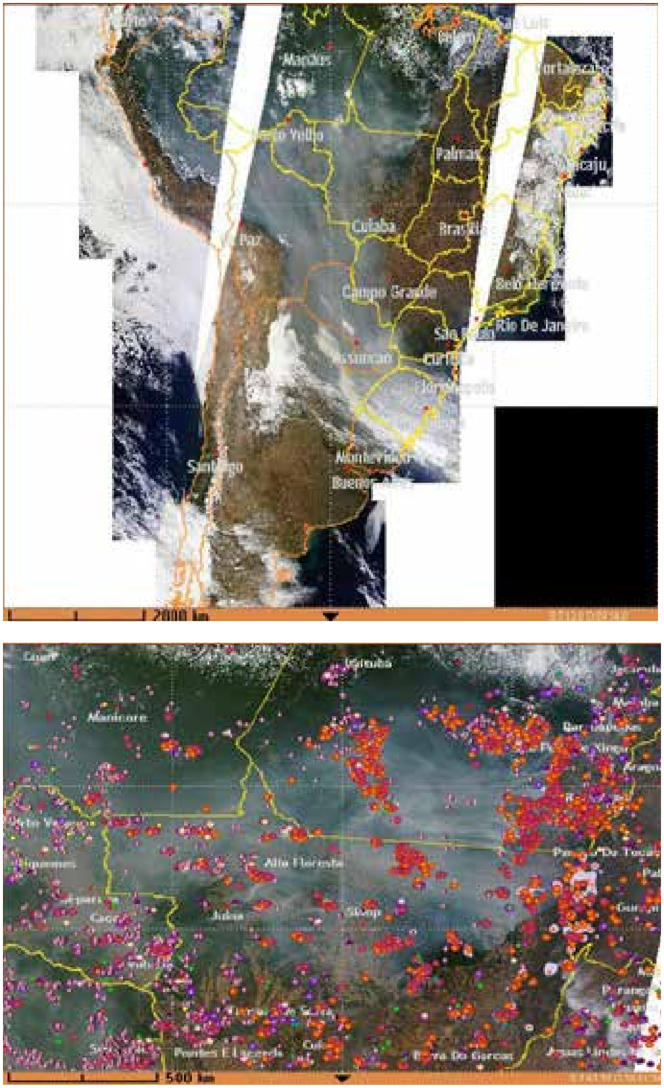
An important aspect that should be considered when analysing the pressures on air quality refers to the use of energy and the intensity of changes in land use patterns. **Figure 2.1.1** shows the energy balance for LAC: transport and industry are leading sectors in demand for energy and, in turn, the leading sources of pollutant emission. Residential sources cannot be neglected, as the use of biomass for heating and cooking is common throughout the region.

Figure 2.1.1: Energy matrix in Latin America and the Caribbean, 2013 (all figures in kBOE/day).



Source: IDB 2016a based on IEA data and other sources

Figure 2.1.2: On 23 August 2010 Brazilian INPE´s fire system (INPE 2015a) using NASA-AQUA MODIS imagery observed a plume of smoke covering several million square kilometres flowing southwards from Amazonia and advecting into the South Atlantic Ocean in the extreme south of Brazil. The detail shows individual detections of fires and the associated smoke plumes.



Source: INPE 2015

Fossil fuel power stations are also an important source of emissions in LAC, particularly in the Caribbean. There are also many industries in the region that use a variety of fuels in their own power plants, but the emissions from these in most cases are not reported, so it is very difficult to estimate and assess their impact. There are also several industries and industrial processes which involve the combustion of a range of materials. Their emissions, however, are poorly understood and documented.

The burning of biomass as an energy source for cooking and heating is still widely used in LAC, usually in rural areas, and is also a major cause of indoor air pollution. The use of fire in agriculture is widespread in the region. Native forests, grasslands and other natural habitats are burnt after being cleared to provide more land for agriculture; in some areas fire is also used as part of crop rotation practices. Overall, emissions from agriculture and deforestation-related fires in the region are a major contributor to atmospheric trace gases and aerosol mass concentrations (see for example **Figure 2.1.2**). In 2014, the net amount of CO_2 emissions/removals related to land use[4] in South America was 709 554 gigagrams (FAO 2015).

Another important source related to fire in the region is the open burning of waste; this releases new chemicals into the atmosphere, mostly toxic chemicals with negative effects on human health (Laborde *et al*. 2015). Waste and sanitary landfills are also sources of emissions, although they are considered as a minor contributor in LAC. However, data on these is very scant, making it difficult to provide a robust assessment of the magnitude and impacts from this source. The estimate of 36 per cent of methane emissions coming from waste in Peru (World Bank 2013; La Giglia *et al*. 2014) gives some clues about the role of waste in atmospheric pollution in LAC.

4 Includes forest land, cropland, grassland and biomass burning.

2.1.3 State and trends

Air quality data and concentrations

The WHO cities database released in 2014 shows that most of the cities in the region for which data are available have concentrations of particulate matter above the WHO guidelines (**Table 2.1.1**). This means that most of the urban population in the region is exposed to poor air quality, with consequences for both health and the environment.

Particulate matter $PM_{2.5}$ and PM_{10}

The data analysed in the report by the Clean Air Institute (Green and Sanchez 2012) strongly support the concern over particulate matter and ozone. Of the 16 cities that measured concentrations of PM_{10} in 2011, all exceeded the WHO annual air quality guidelines of 20 micrograms per cubic metre (annual mean) and nine exceeded the EU annual standard of 40 micrograms per cubic metre (**Figure 2.1.3**). From the 11 cities that recorded concentrations of $PM_{2.5}$ in 2011, 10

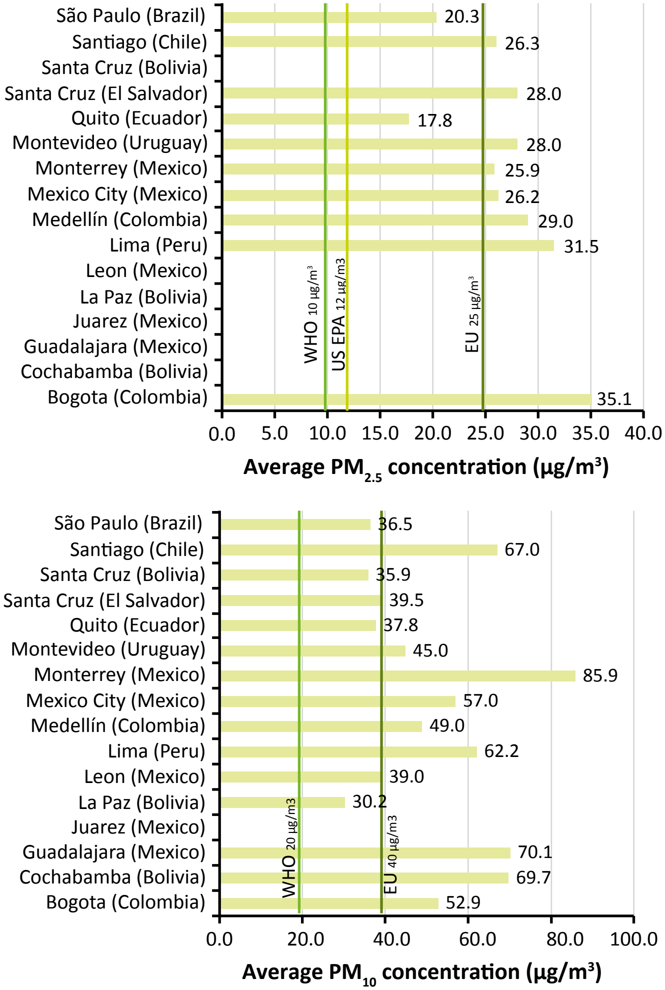
Table 2.1.1: Annual mean concentration of particulate matter of less than 10 microns of diameter (PM_{10}) [µg m^{-3}] and of less than 2.5 microns ($PM_{2.5}$) in major cities in LAC countries.

Country	PM_{10}: annual mean, mg m^{-3}	Year	$PM_{2.5}$: annual mean, mg m^{-3}	Year	Number and type of monitoring stations
Argentina	30	2012	16	converted	3 stations, 2 stations in residential/ commercial with fixed sources and 1 in mixed zone with medium to low traffic in capital city
Bolivia	51	2010	27	converted	5 stations in 2 cities
Brazil	41	2012	22	converted	>56 stations in 40 cities
Chile	64	2011	28	2008-2012	47 stations in 24 cities
Colombia	43	2010-2012	24	converted	37 stations in 10 cities
Costa Rica	31	2011	17	converted	8 stations in 4 cities
Ecuador	38	2012	18	converted	9 cities
Guatemala	45	2012	33	2012	4 stations in capital city
Honduras	58	2013	32	2013	2 stations in capital city
Jamaica	36	2011	20	converted	12 stations, mixed, in 3 cities
Mexico	79	2011	27	2011	>24 stations in 9 cities
Paraguay			18	2010	3 stations in capital city
Peru	63	2011	38	2011	4 stations in capital metropolitan region
Uruguay	27	2012	18	2012	2 stations for PM_{10}, 1 station for $PM_{2.5}$, in capital city
Venezuela	47	2011	26	converted	Monitoring in 2 cities

Note: Annual mean PM_{10} data were estimated, when not available, on the basis of $PM_{2.5}$ using a conversion factor. As the conversion factor $PM_{2.5}/PM_{10}$ may vary according to location, the converted PM_{10} value for individual cities may deviate from the actual value (generally between 0.3 and 0.8), and should be considered as approximate only.

Source: WHO 2014c

Figure 2.1.3: Annual average concentrations of $PM_{2.5}$ and PM_{10} (µg m⁻³) in selected cities in Latin America and the Caribbean (2011). The vertical lines represent respectively WHO, US-EPA, and EU quality standards for PM defined as the annual average of maximum amount of airborne particles that can be present in outdoor air without threatening the public's health.



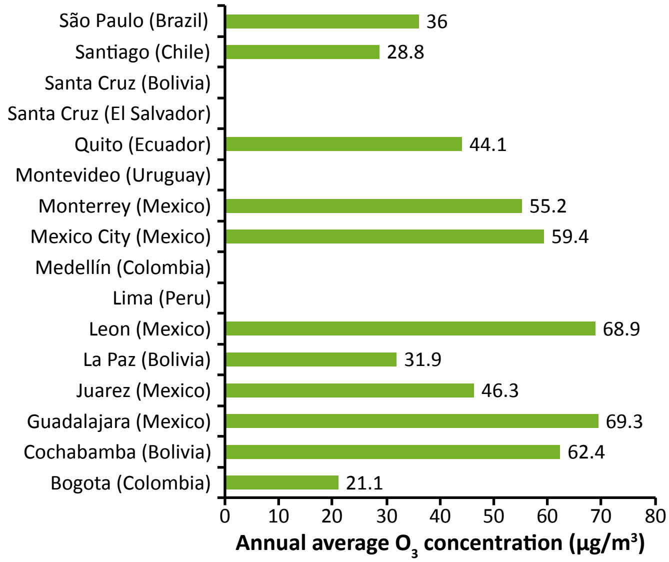
Source: Green and Sanchez 2012

exceeded the annual WHO air quality guideline of 10 micrograms per cubic metre (annual mean) and the US EPA annual standard of 15 micrograms per cubic metre, and 8 of them exceeded the EU annual standard of 25 micrograms per cubic metre. All of the exceedances were also over the WHO Interim Target 3 of 15 micrograms per cubic metre (annual mean).

Ozone

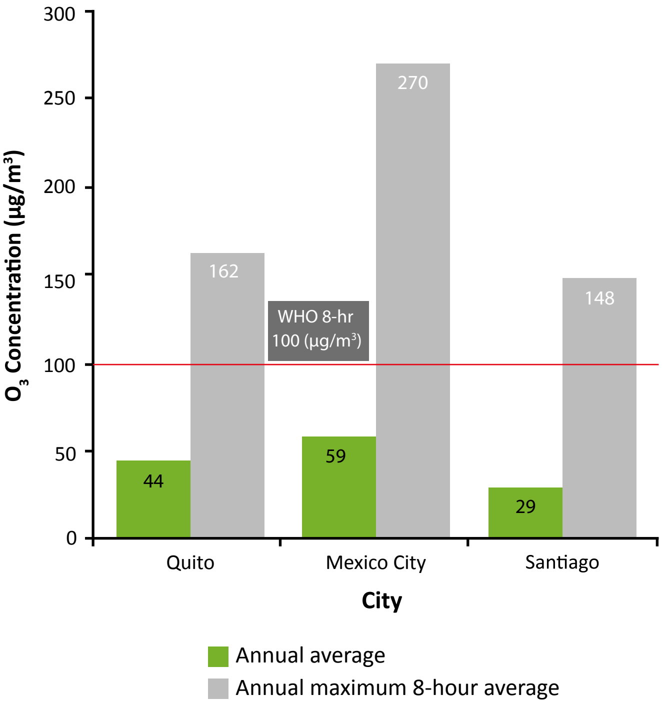
The significant variation in annual average ozone concentrations across the region (**Figure 2.1.4**) suggests that there are spatial differences in the key drivers of ozone formation i.e. the emissions of ozone precursor pollutants and the solar radiation required for the photochemical transformation processes that lead to ozone formation.

Figure 2.1.4: Annual average ozone concentration in selected cities in Latin America and the Caribbean in 2011.



Source: Green and Sanchez 2012

Figure 2.1.5: Annual average ozone concentration and maximum eight hour average concentration (gray bar) in three major cities in Latin America in 2011. The horizontal red line represents the WHO standard for ozone exposure (eight-hour average).



Source: Green and Sanchez 2012

The exceedances of the 8-hour WHO air quality guidelines in all the considered cities (**Figure 2.1.5**) suggests that even cities with a low annual average concentration are likely to have short-term concentrations of ozone above what is deemed unsafe for public health by WHO.

Persistent Organic Pollutants (POP) levels in air

The Global Monitoring Plan (GMP) is an initiative established to evaluate the effectiveness of the Stockholm Convention and monitor the presence of POPs in all the regions, including LAC. The second regional monitoring report for LAC, published in November 2014, includes several datasets available from air samples throughout the region in (UNEP 2014a). The sampling method for providing comparable results consisted of establishing a network of passive sampling stations, including urban, rural and background sites. These methods use polyurethane foam (PUF Samplers) and Styrene divinilbenzene samplers (XAD-2 resin).

Greenhouse gases

Transport is one of the largest and fastest growing sources of GHG emissions in Latin America and the Caribbean. The transport system in the region together with the increase in motorization rates have led to an increase in the overall regional GHG emission rates, also in part due to the growing GDP and the increase of the middle class across the region. The transportation sector represents 35 per cent of the total GHG emission in Latin America and the Caribbean, accounting for 506.4 million tonnes of carbon dioxide per year (IDB 2013). A description of the main greenhouse gases emitted in LAC is provided in the Supplementary Information (**More…6**).

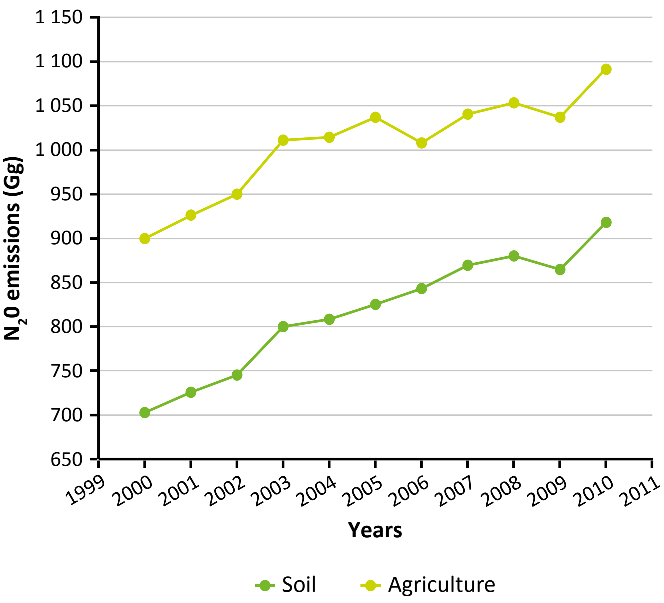
Nitrous oxide

Agriculture has a strong effect on emissions of nitrous oxide (**Figure 2.1.6**) and, to a lesser extent, carbon dioxide. Nitrogen fertilizers result in emissions of nitrous oxide from the soil and these emissions increase rapidly with the amount of fertilizer added to crops. In LAC nitrous oxide emissions from soils, from leaching and runoff, direct emissions, and animal manure, increased by about 29 per cent between 2000 and 2010.

Methane

Methane emissions from rice (paddy) cultivation increased significantly and fairly linearly at a rate of 32 gigagrams methane per year during 2000-2010 (**Figure 2.1.7**). In these years, methane emissions increased by about 29 per cent. The percentage share of total global methane emissions from rice (data only from Africa, Asia and Pacific, Latin

Figure 2.1.6: N_2O emissions from soil emissions and agriculture (gigagrams) in LAC. Refer to the main text for the N_2O processes each of these sources represents.



Source: UNEP 2015d

America and North America) also showed a significant and fairly linear trend in 2000-2010. The share in that period increased by 15 per cent.

The livestock population in LAC is mostly beef and dairy cattle. The abundance of ruminants in the region results in large methane emissions, mostly from enteric fermentation (**Figure 2.1.8**). With a growing livestock population, these emissions from enteric fermentation increased significantly and linearly at a rate of 448 gigagrams methane per year in 2000-2010, resulting in a 19 per cent increase in emissions. The share of these emissions in the total global emissions from the same source and period also showed a significant and fairly linear trend: emissions in 2010 were 7.3 per cent higher than in 2000.

Figure 2.1.7: LAC methane (CH_4) emissions from rice cultivation (left axis) and their relative share of global total methane emissions from the same source (right axis).

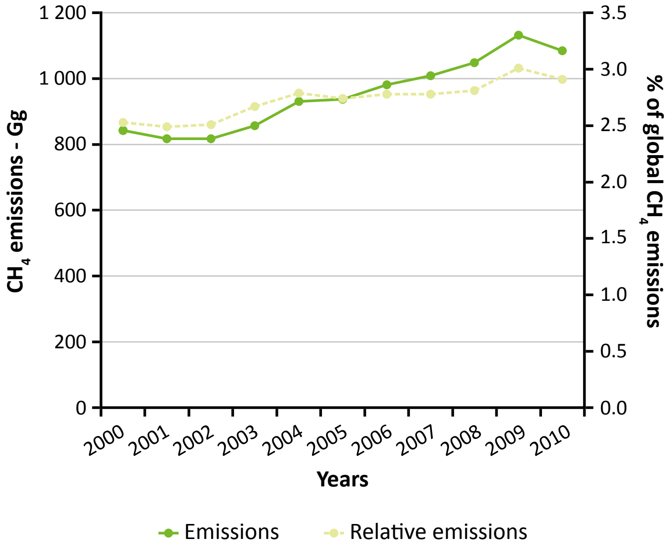
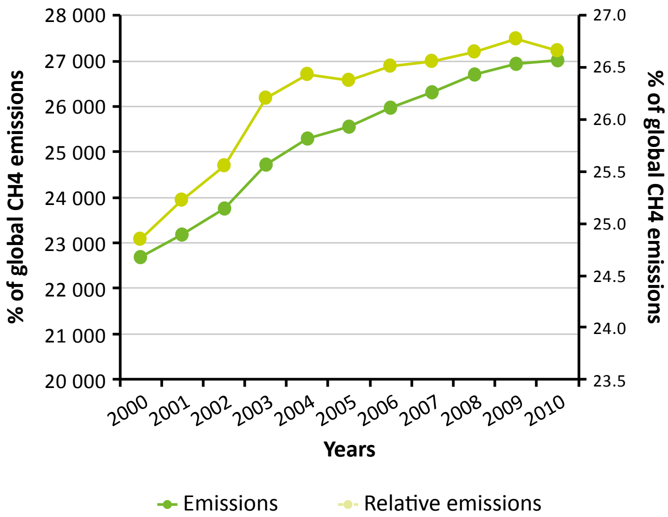


Figure 2.1.8: LAC CH_4 emissions from enteric fermentation in cattle (left axis) and their relative share of global total methane emissions from the same source (right axis).



Globally, 5 per cent of methane emissions from livestock come from manure management[5]. Although the amount is about one-eighth of the mean methane emissions from enteric fermentation, improving the management of manure to reduce these emissions is currently much simpler than acting on enteric fermentation.

Carbon dioxide emissions

The most recent data for carbon dioxide emissions in LAC is from 2011 (World Bank 2015). This data shows interesting patterns, especially when the contributions of each sub-region are considered (**Figure 2.1.9**). In general, carbon dioxide emissions are on the increase, mostly in South America, with countries like Argentina, Brazil, Mexico and Venezuela, each of them exceeding 150 million tonnes per year.

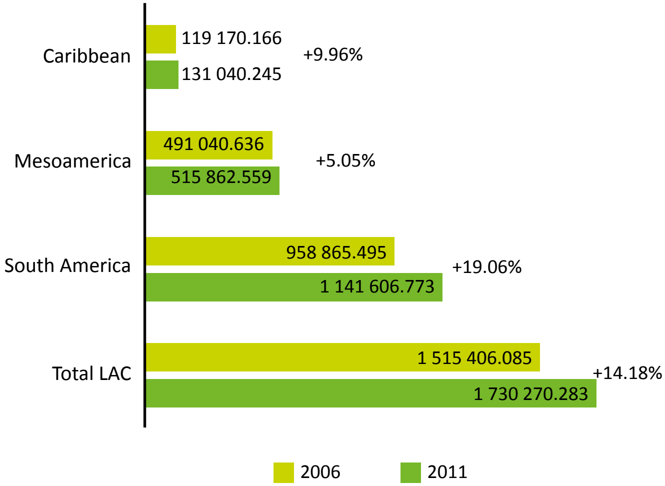
A further analysis of the carbon dioxide emissions in LAC over a five year observation period (2006-2011), shows some differentiated patterns in the region. The difference in total emissions between 2006 and 2011 at national level accounts for an average increase of 14 per cent in LAC, with Peru, reporting 50 per cent more CO_2 emitted in 2011 with respect to 2006 and a small group of countries (El Salvador, Guatemala, Suriname and Jamaica) reporting a decrease in the CO_2 emitted in 2011 (**More...7**).

A normalization of the data reported above by the number of inhabitants provides a clearer picture of the emission levels by country in LAC. Of particular concern are the emissions in Trinidad and Tobago, which exceeds the 37 tonnes per person in 2011. In general, only 6 countries were able to reduce their emissions per person as reported in 2011 with reference to 2006. Among them, Jamaica, Guatemala and Suriname were able to reduce their emissions by more than 20 per cent.

Figure 2.1.10 provides an additional perspective on the emissions, in relation to GDP and population. The Mercosur economic area, which is the largest in terms of both population and GDP, has the greatest share in CO_2 emissions in LAC. On the other end are the countries from the Mesoamerica Integration System (SICA), which have the lowest emission level in the region.

Fires of anthropogenic origin are quite an important source of emission in the region. Occurrence of wildfires of anthropogenic nature is common in South America during the winter season (June to September) when fires are lit to clear vegetation or biomass waste when land is converted to agriculture or forestry. Biomass burning produces many pollutants including carbon dioxide, carbon monoxide, sulphur dioxide, nitrogen oxides, methane, ammonia, dimethyl sulphide, non-methane organic compounds, halocarbons, and gaseous organic acids. Carbon monoxide and nitrogen oxides are ozone precursors.

Figure 2.1.9: Total emissions of carbon dioxide in 2006 and 2011 (kilo tonnes per year) in LAC subregions.

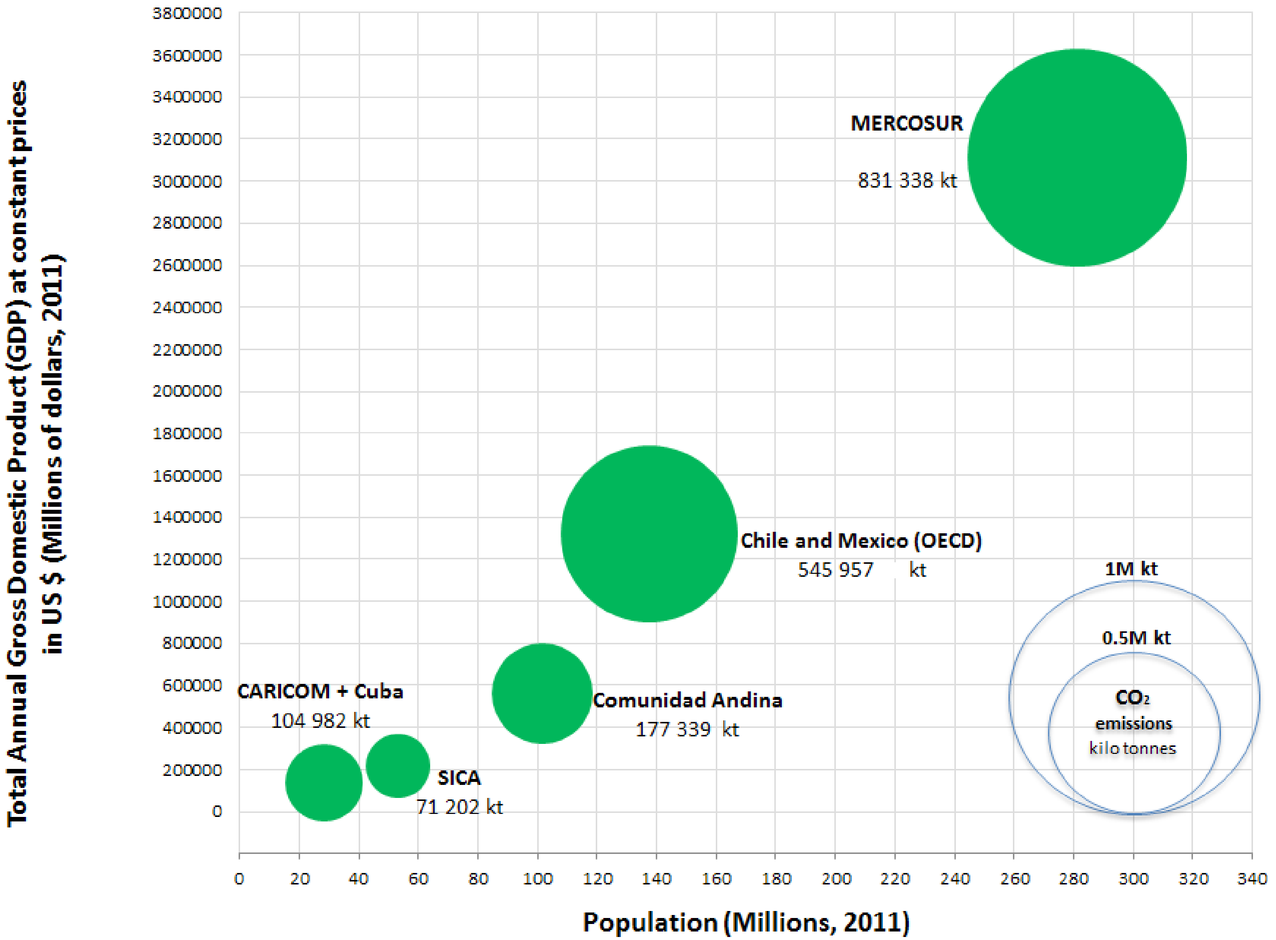


Note: The emissions reported are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

Source: World Bank 2015

5 GLEAM 1.0 - Assessment of GHG emissions and mitigation potential. www.fao.org/gleam/results/en/

Figure 2.1.10: Total CO_2 emissions (2011) per economic area in LAC according to GDP and population.



Note: the emissions reported are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

CARICOM: Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Jamaica, Montserrat, Saint Lucia, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago

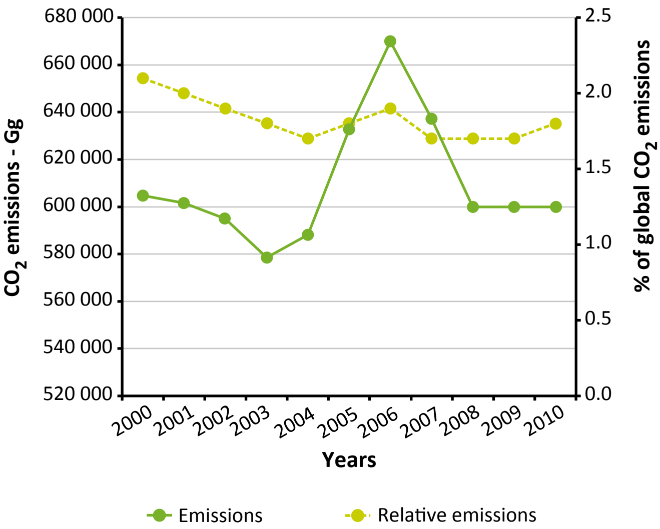
Comunidad Andina: Bolivia, Colombia, Ecuador, Peru

MERCOSUR: Argentina, Brazil, Paraguay, Uruguay, Venezuela

Sistema de la Integracion Centramericana (SICA): Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Nicaragua, Panama

Source: World Bank 2015

Figure 2.1.11: LAC. Carbon dioxide emissions from forest fires and decay of biomass after burning (left axis) and their relative share of global total carbon dioxide emissions (right axis).



Data are model estimations by EDGAR v.4.2 FT2010.

Source: UNEP 2015

In LAC estimated emissions of carbon dioxide from forest fires were fairly stable with a mean of 609 790 (1.34 per cent)[6] Gigagrams (**Figure 2.1.11**, left axis). These emissions represented a significant[7] and decreasing proportion of the global total carbon dioxide emissions in the period 2001-2010 (**Figure 2.1.11**, right axis), with a mean of 1.81 per cent (1.92 per cent)[8].

6 The number in parentheses next to the value of a mean is the relative uncertainty of the mean, computed as 100 times the ratio of half the value of the 95%- confidence interval for the mean and the mean value.

7 *Significant* (or *significantly*) means a statistical probability equal to or less than 5%.

8 The number in parentheses next to the value of a mean is the relative uncertainty of the mean, computed as 100 times the ratio of half the value of the 95%- confidence interval for the mean and the mean value.

Toxic chemicals

The presence of toxic chemicals in the atmosphere has been documented in the region through the monitoring of POPs regulated by the Stockholm Convention (Barra *et al*. 2007). The wide occurrence, even at low concentrations, of dioxins and furans in urban areas is of concern given the highly toxic nature of these pollutants. For the first time, regional results on dioxin exposure have been documented throughout the LAC region. This was possible thanks to the establishment of a monitoring network, created by the regional centres of the Basel and Stockholm conventions and the support of the Global Environment Facility (GEF) and the scientific community in the region.

2.1.4 Impacts

Health

Impacts of air pollution on human health have been documented both at global and regional levels (WHO 2012). Air pollution is one of the main avoidable causes of disease and death globally. It causes significant morbidity and mortality in all countries. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone and nitrogen and sulphur dioxides. Fine particulate matter ($PM_{2.5}$), which is widespread, both indoors and outdoors, damages the health of more people than any other air pollutant.

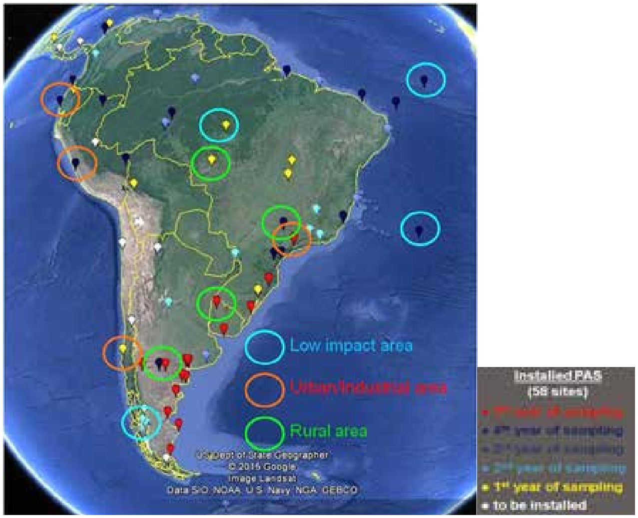
Globally, more than 1.5 million deaths per year from respiratory infections are attributed to the environment, including at least 42 per cent of lower respiratory tract infections and 24 per cent of upper respiratory infections in developing countries (WHO 2015b).

In LAC, an estimated 100 million people live in areas susceptible to air pollution, mostly in highly populated areas of cities with more than 500 000 inhabitants (Romieu *et al*. 2012). In most such cities exposure to $PM_{2.5}$ exceeds the internationally recommended standards (Green and

Latin America Passive Atmospheric Sampling Network

The Latin America Passive Atmospheric Sampling Network (LAPAN) was established in 2010 to enable studies of long-term spatial and temporal trends of atmospheric contaminants (PCB, PBDE, organochlorine pesticides and current use pesticides). The network runs 73 sites, covering areas with different backgrounds (low impact-remote, urban, industrial and rural) including Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Honduras, Peru, Uruguay, and Venezuela. It also includes some sites from Antarctica. The passive atmospheric samplers consist of a stainless steel mesh cylinder filled with XAD-2 (styrene/divinylbenzene – copolymer resin). The highest DDT, endosulfan and PBDE levels were found in Argentina (Fillmann *et al.* 2015).

The use of monitoring networks is recommended for evaluating atmospheric contamination in order to take action on prevention and mitigation strategies.



Sanchez 2012). The groups that are most vulnerable to the health effects from exposure to air pollutants are the elderly, the young, those with chronic health problems and the poor (Green and Sanchez 2012).

In 2010, particulate air pollution was responsible for about 190 million Disability-Adjusted Life Years (DALYs)[9]. This puts the burden of particulate matter air pollution among the biggest risk factors, much higher worldwide than any other, competing or exceeding other environmental risks and risk factors such as smoking, hypertension, malnutrition and alcohol (Smith *et al*. 2014).

9 DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for people living with the health condition or its consequences. See: http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/

A study on mortality in Latin America associated with air pollution (Romieu *et al*. 2012) found that a daily increase in PM_{10} was associated with small percentage increases in daily mortality from all natural causes including from respiratory, cardiopulmonary, cardiovascular, and chronic obstructive pulmonary diseases; and cerebral-vascular stroke in most of the cities studied, even though the strength of the association varied from city to city.

In LAC, 16 per cent of households use solid fuels, although there is a wide variation between countries (IARC 2013). For example, in Guatemala 65 per cent of the total population uses solid fuels, out of which 88 per cent are in rural areas and 29 per cent in urban areas. In the case of Mexico, 15 per cent of the total population uses these fuels, 45 per cent in rural areas and less than 5 per cent in urban areas (WHO 2012). Exposure to pollutants from indoor pollution coming from solid fuel contributes to a higher risk of pneumonia in younger children (Dherani *et al*. 2008). Other impacts include an increased risk of lung cancer (Kurmi *et al*.2012) and chronic bronchitis (Kurmi *et al*. 2010).

Factors such as high-density settlement and other environmental and social conditions of some hazards are responsible of the risks. Poor and wealthy people in Santiago de Chile and Bogotá are comparable in their health risk from air pollution and heat (Magrin *et al*. 2014). The elderly are considered a vulnerable group to air pollution and heat because they have conditions that limit the body's ability to respond to this kind of stress (Gamble *et al*. 2013).

Reducing air pollution does not always promote the objectives of protecting health and climate, but can pose trade-offs. All particles are hazardous to health, and some are contribute to climate warming, such as black carbon, and some contribute to climate cooling, such as sulphates (Smith *et al*. 2009). In fact, if all anthropogenic particles are eliminated in the atmosphere, it would be a great success for health, but only have a minor net impact on climate change (Smith *et al*. 2014).

IPCC (2013) indicates that there is little evidence that climate change, by itself, will affect the levels of particulate matter in the long term in a consistent manner. Some scenarios of future climate change indicate that chronic exposure to ground level ozone can be improved (Smith *et al*. 2014).

If temperature rises, many air pollution models project an increase in ground level ozone production, particularly in urban areas and surroundings (Hesterberg *et al*. 2009). Increased temperature also accelerates ozone destruction, and it is believed that the net direct impact of climate change on ozone concentrations around the world can be reduced (IPCC 2013). However, some scenarios (IPCC 2013) suggest that tropospheric ozone can be increased through increased methane emissions stimulated by climate change. Models also show that local variations may produce a different result at the global level (Selin *et al*. 2009).

In 2012 a total of 138 000 deaths in the Americas (low and middle income) were attributed to ambient air pollution (58 000) and household air pollution (80 000) (WHO 2014a, WHO 2014b). Deaths per person due to ambient and household air pollution were 47 per 100 000 people, mainly due to ischaemic heart disease, stroke and chronic obstructive pulmonary disease (WHO 2015b).

Health and costs of air pollution in Latin America and the Caribbean

WHO and others, including the Health Effects Institute (HEI), have estimated country and regional levels of health impacts from air pollution, by using mortality as an indicator. The SCALA study (HEI 2012), used a methodology for attributing mortality to measured environmental levels of air pollutants such as PM_{10} and ozone. The use of a common methodology concluded that a small but significant link exists between mortality data and exposure to PM_{10} and ozone. Comparatively, these results were similar to those observed in other parts of the world by using the same methodological approach. These results, considering the lack of information at the city level and its relation with natural corridors to connections to ecosystems, is becoming a powerful tool to support investment in the improvement of public transport, cleaner fuels, development of low-emission technologies and other interventions that promote more sustainable cities and cleaner air. This kind of valuation should be promoted in the region in order to provide decision makers and communities with information about the impact of air pollution in their cities.

2.1.5 Response

In December 2015 at the 21st Conference of the Parties of the UNFCCC, governments of LAC presented their Intended Nationally Determined Contributions (INDC) (**More... 8**). In March 2014, the XIX Meeting of the Forum of Ministers of Environment for Latin America and the Caribbean adopted the Regional Plan of Action on Atmospheric Pollution[10], as an example for the development of national action plans appropriate to the particularities of each country with emphasis on technical exchange, capacity building and design alternatives to reduce air pollution (**More...9**).

This plan, which is the first of its kind in the world, recognizes the importance of the issue of air quality for the healthy development of the LAC population and the conservation of the environment, and encourages governments to identify the economic resources needed for the sustainability of the air quality monitoring networks as an essential and priority element for decision making.

The plan provides a guide for developing national action plans appropriate to each country to reduce air pollution. The ministers' decision includes provisions to update the plan every four years and encourage governments to identify economic resources needed for maintaining air quality monitoring networks as an essential and priority element for decision making. It also commits to strengthening public-private dialogue and emphasises the role of all sectors and levels of government involved in the promotion of commitments and actions to implement the overall plan.

Short Lived Climate Pollutants

Because of their relatively short life in the atmosphere and high radiative forcing, substances such as methane, black carbon, tropospheric ozone and many hydrofluorocarbons (HFCs) have been categorized as short-lived climate forcers (UNEP 2011b). Since black carbon, tropospheric ozone and methane affect air quality, these substances have also been called short-lived climate pollutants (SLCP).

In 2012, the Climate and Clean Air Coalition (CCAC) decided to undertake a major integrated assessment of Short Lived Climate Pollutants (SLCP) in LAC, to support and provide a framework for national action, underpin regional co-operation on SLCP mitigation, and provide a regional focus for engagement with policy makers, scientists, technical experts, and other key stakeholders. The report includes a review of the available data on SLCP and Criteria Pollutants for the region. In order to assess the emissions, the LAC region was subdivided into 13 countries and groups of countries. The estimates included in the regional assessment of SLCP constitute the first comprehensive emissions inventory for the whole region for all sectors and substances at a detailed level.

Air quality standards

The air quality standards situation is heterogeneous in the region. While it is encouraging that many countries and cities in LAC have set official air quality standards to protect health, some countries still lack such legislated standards. Even when standards exist they sometimes exceed the WHO guidelines (WHO 2006). In other cases countries do not have national $PM_{2.5}$ standards and both the annual and 24-hour PM_{10} standards for all countries are higher than the WHO air quality guidelines. Most countries also have standards set significantly above the WHO 1-hour air quality guidelines or have no short-term standard at all, which is crucial, since the health effects of nitrogen dioxide are most significant with short-term exposure.

Air quality monitoring

LAC has a limited number of air quality monitoring programmes in place. Existing air pollution monitoring capabilities are restricted to some countries where air pollution is a serious problem, in metropolitan areas and a few other places. Buenos Aires, Mexico City, Sao Paulo and Santiago de Chile have good monitoring examples that could be replicated in other cities.

Air quality management plans at local level

Major cities in LAC have worked to implement air quality management plans over the past three decades. There

10 http://www.pnuma.org/forodeministros/19-mexico/documentos/decisiones/Contaminacion_Atmosferica/Decision_on_Air_Pollution.pdf

are successful examples that highlight the importance of comprehensive, long-term efforts (see for instance CAME 2011), but many of the cities have still not established their plans. A combination of incentives, technological changes, taxes, and the 'polluter pays' principle, played a role in achieving the policy implementation in each case. In Chile, the reduction of particulate matter releases involved the development of cleaner fuels by reducing the sulphur content in diesel and gasoline, better car regulations, by mandating the use of catalytic converters (improving combustion efficiency), transport restrictions according to the level of air quality, reduction of the most polluting vehicles from the public collective transportation system, the introduction of diesel particulate filters (DPF), and low emission vehicles (Euro 5 standard) in public transportation fleets (**More...10**).

2.2 Freshwater

2.2.1 Overview and main messages

In 2005, the General Assembly of the United Nations (UN) in its resolution A/RES/58/217, proclaimed 2005–2015 as the International Decade for Action, *Water for Life*. The resolution states that the main goal of the decade should be a greater focus on water-related issues at all levels, and on the implementation of water-related programmes in order

Key Messages: Freshwater

The main pressures affecting water quality and quantity differ vastly within the sub-regions but have not changed since previous assessments. Agriculture, industries and households demand more water resources than ever before as population growths, the global economy expands and extreme climatic events become more frequent. While the construction of new infrastructure and the development of regulatory instruments are important measures to address the situation, integrated approaches that consider the water-energy-food nexus are necessary.

Data on water quality and quantity is scarce both spatially and temporally. As a reference, the average density of monitoring stations for water quality that are part to the GEMS/Water Programme Network is only 0.3 per 10.000 square kilometres (UNEP 2016). There is also a need to develop technical and research capacities to assess the state and trends of water and to build on information gathering and sharing. This information is key for any management effort, just as information on employment, GDP or poverty is essential to run economic policies.

Climate change translates into hydrological variability and in turn to shifting agricultural seasons, frequent extreme climatological events and glacier retreat. In terms of decision making, this represents important uncertainties and challenges in natural resources management. Therefore, a robust and effective structure for water governance that follows an integrated approach should be implemented at all levels. In recent years, many examples of good practices in water resources management have been implemented at the local scale in the region. It is time to upscale these experiences to national and regional contexts.

To fully achieve the SDGs and the human right to water and sanitation, it is necessary to change current consumption and production patterns across all sectors, reducing water loss, updating technologies and conserving ecosystem services.

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