مركز الإحصاء
STATISTICS CENTRE

Methodology

Air Quality
Statistics

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1. Overview

1.1. Introduction

Primary air quality data in Abu Dhabi are collected by the Environment Agency of Abu Dhabi. SCAD collects and publishes these data. The data are collected from nineteen air quality monitoring stations, located around Abu Dhabi Emirate. Data for each individual monitoring station is published. The pollutants measured are: nitrogen dioxide, sulphur dioxide, carbon monoxide, ground-level ozone, and coarse particulate matter (PM10). SCAD also calculates an air quality index (AQI) which shows the level of each of these pollutants relative to international guideline levels.

SCAD calculates the average and maximum concentration of pollutants measured at a series of monitoring stations in each month and in each year. Average concentration statistics are released in quarterly and annual reports.

The methodology used to calculate these air quality statistics is consistent with international best practices and recommendations in this field.

1.2. Concepts and definitions

Air quality is the degree to which the air in a locality is pollution-free.

Air pollution is the presence of toxic or harmful substances in air.

Airborne diseases and conditions associated with the environment are caused or worsened by exposure to unhealthy levels of pollutants (such as particulate matter, sulphur dioxide or ground-level ozone), usually found in urban settlements and, in particular, in cities with weaker air quality regulations and/or enforcement capabilities.

Emissions to air are gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption and accumulation processes.

SCAD publishes air quality data on the concentration of six types of pollutants in the air. These are:

Ground-level ozone is a greenhouse gas which also causes respiratory problems. It is formed by the reaction of various vehicular and industrial emissions with UV radiation.

Sulphur dioxide is a toxic gas created by burning fossil fuels which contain sulphur.

Nitrogen dioxide is a toxic gas that causes respiratory problems, emitted by the burning of fuel, especially in internal combustion engines.

Carbon monoxide is a toxic gas emitted by internal combustion engines.

Particulate matter (PM10) is coarse particulate matter, or PM10: any particles suspended in air which are less than 10 micrometers in diameter. These particles cause respiratory problems due to their size, even if they are of non-toxic substances.

Particulate matter (PM2.5) is fine particulate matter, or PM2.5: any particles suspended in air which are less than 2.5 micrometers in diameter. These particles cause respiratory problems due to their size, even if they are of non-toxic substances.

1.3. Abu Dhabi special considerations

It should be noted that Abu Dhabi is an emirate and one of 7 emirates in UAE, and data collected is limited to Abu Dhabi emirate. However, since the administrative sources used for collating data pertinent

to air quality statistics also operate at the emirate level, this should not be a factor which compromises data quality.

1.4.   Classifications and standards applied

SCAD publishes air quality data in accordance with the UN Framework for the Development of Environmental Statistics (FDES)[1], which recommends the publication of data on concentration levels of six pollutants: ground-level ozone, sulphur dioxide, carbon monoxide, nitrogen dioxide, coarse particulate matter (PM10), and fine particulate matter (PM2.5).

In accordance with FDES (2013), SCAD publishes the monthly and annual average concentration of these pollutants in ambient air.

1.5.   Available breakdown

SCAD publishes air quality data for three subregions of the Emirate:

- Abu Dhabi Region
- Al-Ain Region
- Al-Dhafra Region

Within this, data for each of the individual monitoring stations is published. The measures of air quality published are:

- Sulphur dioxide concentration
- Particulate matter (PM10) concentration
- Particulate matter (PM2.5) concentration
- Nitrogen dioxide concentration
- Ground level ozone concentration
- Carbon monoxide concentration

This data is published as monthly and annual figures.

1.6.   Importance and objectives of the indicator

Measurements of concentrations of substances in the environmental media reflect the combined and cumulative impact of human and natural processes. This pollution impacts both the human subsystem and ecosystems. Policymakers, analysts and civil society require statistics on environmental quality to monitor and make evidence-based policies to maintain and improve environmental quality globally and in each country. Pollutant concentration statistics provide information on the quality of environmental media. The importance of pollutants may vary when considering the quality of the ecosystem or the health and well-being of humans and other living beings. Air pollution is one of the most serious environmental threats to human life. Lowering air pollution levels can help countries reduce the global diseases burden caused by infectious respiratory diseases, cardiovascular diseases, and lung cancer. Reducing air pollution is a key area in which governments can strive to achieve United Nations Sustainable Development Goal 3: Good Health and Wellbeing, and Goal 11: Sustainable Cities and Communities.

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1   See https://unstats.un.org/unsd/envstats/fdes.cshtml

2. Indicator information

2.1. Geographical coverage

SCAD publishes air quality data for three subregions of the Emirate: Abu Dhabi Region, Al-Ain Region, and Al-Dhafra Region. The exclusion of the fourth subregion, The Islands, is in line with international standards, as air quality data is usually only published for urban areas.

Within these subregions, data is published for each monitoring station. The monitoring stations are:

Station Name	Region	Station Type	Latitude	Longitude
Khadejah School	Abu Dhabi	Urban	24.481558	54.369329
Khalifa School	Abu Dhabi	Suburban	24.430092	54.408431
Hamdan Street	Abu Dhabi	Traffic	24.488927	54.363716
Baniyas School	Abu Dhabi	Suburban	24.321339	54.635928
Mussafah	Abu Dhabi	Industrial	24.3472	54.502884
Al Mafraq	Abu Dhabi	Industrial	24.286284	54.588875
Khalifa City A	Abu Dhabi	Suburban	24.419918	54.5578195
Al-Maqta	Abu Dhabi	Urban	24.403521	54.516095
Al-Ain Islamic Institute	Al-Ain	Suburban	24.219059	55.734863
Al-Ain Street	Al-Ain	Traffic	24.225859	55.765832
Al-Qua'a	Al-Ain	Rural background	23.531154	55.48596
Zakher	Al-Ain	Urban	24.163467	55.702106
Al-Tawia	Al-Ain	Suburban	24.259183	55.704869
Sweihan	Al-Ain	Suburban	24.46666	55.342883
Bida Zayed	Al-Dhafra	Suburban	23.652263	53.703891
E11 Road	Al-Dhafra	Traffic	24.035157	53.88531
Ruwais	Al-Dhafra	Industrial	24.090855	52.754804
Gayathi School	Al-Dhafra	Suburban	23.835512	52.810326
Liwa Oasis	Al-Dhafra	Rural background	23.095785	53.606413
Habshan South	Al-Dhafra	Industrial	23.750404	53.745289

The number of air quality monitoring stations in Abu Dhabi is in line with international standards for a polity of its size.

2.2. Statistical population

The nineteen monitoring stations listed in the section above constitute the statistical population for air quality statistics in Abu Dhabi.

2.3. Periodicity

Monthly data is made available in quarterly reports via the SCAD website. Annual data is made available in the annual statistical yearbook.

2.4.   Timeliness

Monthly air quality data should be published within a month of the reference period; quarterly data should be published within a quarter of the reference period; and annual data within a year.

2.5.   Units

Air quality is measured by the concentrations of each pollutant in ambient air. The units used are:

- Sulphur dioxide: micrograms of pollutant per cubic meter of ambient air.
- Nitrogen dioxide: micrograms of pollutant per cubic meter of ambient air.
- Ground-level ozone: micrograms of pollutant per cubic meter of ambient air.
- PM10: micrograms of pollutant per cubic meter of ambient air.
- PM2.5: micrograms of pollutant per cubic meter of ambient air.
- Carbon monoxide: milligrams of pollutant per cubic meter of ambient air.

The air quality index (AQI) is unitless.

2.6.   Reference period

SCAD publishes air quality data on a monthly and annual scale.

3. Methodology

3.1.   Alignment to international standards

SCAD publishes air quality data in line with the Tier 1 standards set out in FDES (2013).

3.2.   Data sources

SCAD does not collect primary air quality data. Primary data is collected by the Abu Dhabi Environment Agency via a series of monitoring stations located around the Emirate. Impact stations are situated near major sources of pollution and measure the direct impact on local air quality. Regional stations measure how pollution is transported and changes through space and time. Background stations provide data on natural conditions.

3.2.1   Survey data

The air quality statistics are based on administrative data only.

3.2.2   Administrative data

SCAD collects air quality data form the Environment Agency of Abu Dhabi. This data is collected from a series of monitoring stations, located around the Emirate.

3.3.   Data validation and editing

3.3.1   Data validation

Data editing allows for the identification of missing data. Missing data might be corrected by contacting the respondent or administrative data supplier once again, carrying forward the last observation in time-

series studies, replacing the missing value with a set of plausible values or estimating the missing data based on parameters which have already been estimated. Any suggested amendments are checked after the data is entered and a list of data error indicators is produced to assess the level of accuracy of the data and to drive continued improvements in data accuracy.

The Statistical Data Quality Framework for Abu Dhabi outlines the quality standards which SCAD is committed to achieve, whether the source of such data is statistical surveys or administrative records. The framework seeks to create a unified understanding of statistical quality for all entities in the Statistical System in the Emirate of Abu Dhabi (SSAD), which will enable these entities to prepare consistent mechanisms and procedures in order to monitor, evaluate and develop the statistical quality of its administrative data.

Furthermore, the Manual of Statistical Quality Standards and Procedures for Administrative Records presents key standards and procedures to ensure the statistical quality of administrative records data. The manual, which is consistent with adopted international and local standards, outlines and describes the following quality dimensions:

1. Organizational structure
2. Relevance
3. Clarity of administrative records preparation methodology
4. Accuracy
5. Coherence and consistency
6. Accessibility
7. Timeliness, periodicity and punctuality

3.3.2   Missing data adjustments

SCAD obtains air quality data from the Environment Agency of Abu Dhabi. The published air quality statistics are final and are not subject to future reviews as a result of any new data that becomes available. If an error is discovered, there are procedures that were previously established with the Project Management Office to remove/amend the published error. These procedures are in line with the policy of the Statistics Centre - Abu Dhabi. In accordance with these, any amendments to previous data in each report will be noted.

3.4.   Data processing

SCAD calculates the following air quality statistics:

- Mean concentrations of pollutants in ambient air
- Peak concentration of pollutants in ambient air
- Number of days during which the pollutant exceeded the guideline limits
- Number of days during which the air pollutant was within the guideline limits

Peak Concentration is the highest concentration of the given pollutant observed during the reference period.

Mean Concentration is the average concentration of the given pollutant over the reference period. It is equal to the sum of all concentration observations, divided by the number of concentration observations.

Guideline Limits
- SCAD calculates the number of days during which each air pollutant exceeded the Guideline Limits during a given reference period.
- SCAD calculates the number of days during which the air pollutant was within the Guideline Limits during a given reference period.

The **air quality index (AQI)** is calculated for each pollutant by comparing the average level of the given pollutant over a given time period to the guideline limit level of that pollutant in that time period, using a system of bands. The band into which the average concentration of the given pollutant in the given time period falls is first established.

The exact value of the AQI is then calculated as follows:

$$AQI_{p,t} = \frac{(\bar{x}_{p,t} - x_{p,t}^{min})(v_{p,t}^{max} - v_{p,t}^{min})}{(x_{p,t}^{max} - x_{p,t}^{min})} + v_{p,t}^{min}$$

Where:
p represents the given pollutant.
t represents the given time period.
$\bar{x}$ represents the observed average concentration.
x^{min} represents the minimum concentration value within the given band.
x^{max} represents the maximum concentration value within the given band.
v^{min} represents the minimum AQI value within the given band.
v^{max} represents the maximum AQI value within the given band.

3.4.1. Linking different datasets
SCAD publishes each quarter's data as a separate dataset. Annual data for each year is published in the relevant Statistical Yearbook.

3.4.2. Sample weighting
Weighting is not applicable to the production of the air quality statistics.

3.4.3. Statistical calculation method
SCAD calculates the maximum value of each concentration level in the given time period, the average across the given time period, and the number of days during which the concentration exceeds a threshold in the given time period.

The **maximum** concentration of a pollutant in a time period is the highest concentration value observed during that time period.

The **minimum** concentration of a pollutant in a time period is the highest concentration value observed during that time period.

The average concentration of a pollutant in a time period is the arithmetic mean of concentration observations in that time period. This is equal to the sum of all pollutant concentration observations during the period, divided by the number of observations in the period.

The **air quality index** is calculated individually for each pollutant.

3.4.4. Seasonal adjustment

Seasonally adjusted estimates are not produced for this publication.

3.4.5. Chain linking

Chain linking is not applied to this production.

4. Special cases

The air quality statistics do not present special cases of indicators.

5. Outputs and quality

5.1 Dissemination and accessibility

Data are disseminated in SCAD official website and available in Excel and PDF on annual basis.

5.2. Length of available dataset

Monthly data is available back to the first quarter of 2019. Annual data is available back to 2009.

5.3. Methodology changes

Air quality statistics is not subject to methodological changes.

5.4. Data coherence and comparability

There have not been any methodological changes to SCAD's air quality data that would prevent historical comparison.

5.5. Data accuracy and potential sources of errors

SCAD do not calculate primary air quality data. SCAD calculates averages, maxima, minima, and the number of days for which levels exceed a certain threshold. Whilst the potential for error exists here, it is minimal.

5.6. Revision policy

Air quality statistics are prepared on a monthly, quarterly and annual basis, in the second quarter of the calendar year following the data reference period. The published Air quality statistics are final and are not subject to future reviews as a result of any new data that becomes available. If an error is discovered, there are procedures that were previously established with the Project Management Office to remove/amend the published error. These procedures are in line with the policy of the Statistics Centre - Abu Dhabi. Thus, the following year's report will contain amendments.

5.7. Limitations of dataset

It should be noted that the context of each monitoring station heavily impacts on air quality at that location. For example, air pollution is considerable higher in the proximity of major roads or heavy industry.

6. Institutional environment

Statistics Centre – Abu Dhabi (SCAD), as the competent government entity in charge of organizing statistical activities in the emirate, plays a pivotal role in supporting decision-makers, and policymakers in Abu Dhabi. The statistical activities in the emirate are organized by SCAD, with its strategic partners in the Statistical System of Abu Dhabi. The Law entrusts SCAD with the task of developing and organizing statistical in Abu Dhabi Emirate.

7. Glossary

Monitoring Station:

A facility dedicated to measuring the emissions or concentrations of pollutants in the environment. There are a number of different types of monitoring stations:

- **Traffic** stations are located near to main roads, and are designed to measure the air pollution created by road vehicles.
- **Industrial** stations are located near heavy industrial activity, and are designed to measure the air pollution created by this activity.
- **Urban** stations are located in densely populated areas.
- **Suburban** stations are located in populated areas.
- **Rural** stations are located away from human populations. They are designed to measure the level of pollutants in the atmosphere away from human activity.
- **Background** stations are located in mixed locations, where no single contributor to air pollution dominates.

Air Pollutant:

Any material whose release into the air, whether happening directly or indirectly, intentionally or accidentally, would change its characteristics in a way that harms human beings, living creatures, natural resources, ambient air, or touristic areas, and thus interfere with other legal uses of ambient air.

Air Quality Criteria (Standards):

Levels of air pollutants determined by relevant regulations that should not be exceeded during a specific period within a specific region.

Sulphur Dioxide (SO2):

A heavy colorless gas with a pungent and irritating odour, produced by the combustion of fossil fuels. It is toxic to animals and plants, and it contributes to the acidification of rain.

Nitrogen Dioxide (NO2):

A reddish-brown gas, commonly seen above cities. It irritates the lungs and has an adverse impact on the environment.

Inhalable Molecules (Molecules of 10 micrometers or less than 2.5 micrometers):

Fine solid or liquid particles, such as dust, smoke, fog, fumes, or smog that are formed or released in the air as a result combustion, industrial activities, or natural sources.

Ground-level Ozone (O3):

Colorless and toxic gas with pungent and irritating odour, an ozone molecule is made up of three Oxygen atoms. The gas is present as a secondary pollutant in the lower atmosphere. Other pollutants may foster its formation. A colorless, toxic gas with a pungent and irritating odour that contains three oxygen atoms in each of its molecules and is present as a secondary pollutant in the lowermost layer of the atmosphere. Other pollutants may contribute to its formation.

Carbon Monoxide (CO):

A colorless, odourless gas resulting from incomplete combustion of fossil fuels. Carbon monoxide binds to haemoglobin in human blood, reducing its capacity to carry oxygen and causing harm to humans.