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## The COVID-19 Pandemic Vs. the Economic Political Dimensions of the Problem of Air Pollution in Poland

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**Abstract:**

**Purpose:** The aim of the article is (1) to investigate whether the short-term reductions of air pollution related to the COVID-19 lockdowns resulted in a significant improvement in air quality in Poland throughout 2020, and thus positively influenced the level of Poland's compliance with the EU's air quality directives, and (2) to analyze the impact of the Covid-19 pandemic on air quality policy (AQ policy) in Poland.

**Design/Methodology/Approach:** The air quality analysis is based on the 24-hour average concentration of particulate matter (PM10), i.e., the primary atmospheric pollutant in Poland, about the EU's air quality standards. Data on surface concentrations of PM10 were retrieved from air quality monitoring stations of the Chief Inspectorate for Environmental Protection. As regards the influence of the COVID-19 pandemic on AQ policy in Poland, the analysis is conducted on a theoretical level, concerning: (1) the two-stage model of AQ policy development (Monks and Williams, 2020), (2) the theory of classification in policy-making (Rhinard, 2019), and (3) the research on the success and failure in public policies, tied to the theories of crisis management (McConnell, 2011).

**Findings:** Research results show that the COVID-19 lockdowns positively impacted Poland's air quality in 2020, and it considerably improved the level of Poland's compliance with the EU's air quality standards. However, the unexpected (i.e., not exclusively related to air quality reforms) reduction of air pollution decreased the pressure to implement policy measures that could lead to a long-term air quality improvement.

**Practical Implications:** Understanding how air pollution is affected by the restrictions on people's mobility and economic activity provides essential information for AQ policy development. Additionally, the article helps raise public awareness of poor air quality in Poland, which is also of great importance for AQ policy development.

**Originality/Value:** This is the first study to investigate whether the short-term reductions of air pollution during the COVID-19 lockdowns helped Poland comply with the EU's air quality directives.

**Keywords:** Air pollution, air quality policy, COVID-19, Poland.

**JEL codes:** Q5, F5.

**Paper Type:** Research Paper.

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## **1. Introduction**

COVID-19 was first identified in December 2019 in Wuhan, Hubei province of China. Having spread first in Asia, it started a severe global pandemic. The first case of COVID-19 in Poland was registered on 4 March 2020. In the first year of the pandemic, Poland suffered from the spread of COVID-19 like many other countries in the region. At the end of 2020, there have been already 1 294 878 registered COVID-19 cases and 28 554 deaths caused by this disease in Poland.

As air pollution adversely affects human health and life expectancy, it creates social and economic problems. In the case of Poland, the high level of air pollution also raises political issues in the international arena due to insufficient progress in the implementation of the EU's air quality directives. Studies of short (usually one or two months) periods of the Covid-19 pandemic (i.e., periods of reduced people mobility and economic activity – so-called lockdowns) in most cases indicate a significant impact of the policy restrictions related to lockdowns on the level of air pollution in large cities all over the world, including Poland. The aim of this article is (1) to investigate whether the short-term improvement of air quality-related to lockdowns resulted in a significant improvement in air quality in Poland throughout 2020, and thus positively influenced the level of Poland's compliance with the air quality standards contained in EU directives, and (2) to analyse the impact of the Covid-19 pandemic on AQ policy in Poland.

## **2. Literature Review**

Several studies are investigating the impact of short-term lockdowns on air quality in selected cities in Asia (Ghahremanloo *et al.*, 2021; He *et al.*, 2020; Ju *et al.*, 2021; Shehzad *et al.*, 2020), Europe (Briz-Redón *et al.*, 2021; Filonchuk *et al.*, 2021; Higham *et al.*, 2021; Skirienė and Stasiškienė, 2021), North America (Adams, 2020; Berman and Ebisu, 2020), and South America (Krecl *et al.*, 2020; Toro *et al.*, 2021). There are also studies exploring this issue from a global perspective, i.e., covering several countries (cities) from different continents (Fu *et al.*, 2020; Venter *et al.*, 2020). The lockdowns taken into consideration in the studies mentioned above occurred during the first months of the COVID-19 pandemic.

Starting from the global perspective, Venter *et al.* (2020) present a study covering 34 countries, which indicates that short-time lockdown events (defined by the average date of policy restrictions on mobility, workplace closure, and stay-at-home advisories) 'have reduced the population-weighted concentrations of nitrogen dioxide and particulate matter levels by about 60% and 31% in 34 countries. However, despite the overall average decline in air pollution during the lockdown, they noticed a 'substantial variation between countries, in terms of both the direction and magnitude of change' (Venter *et al.*, 2020). The declines in nitrogen dioxide (NO<sub>2</sub>) were relatively ubiquitous over space (in 28 out of 34 countries), but the anomalies concerning particulate matter were more variable. Exploring nationally aggregated

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citizen mobility datasets, Venter *et al.* found a significant association between country specific NO<sub>2</sub> declines and reductions in work commutes and vehicle driving activity. In contrast, no meaningful relationship of this kind was found for particulate matter (PM<sub>2.5</sub>) anomalies.

As far as the studies focusing on selected cities are concerned, they indicate the positive impact of the COVID-19 national lockdowns on NO<sub>2</sub> reduction (Adams, 2020; Berman and Ebisu, 2020; Briz-Redón *et al.*, 2021; Fu *et al.*, 2020; Ghahremanloo *et al.*, 2021; Higham *et al.*, 2021; Ju *et al.*, 2021; Krecl *et al.*, 2020; Shehzad *et al.*, 2020; Skirienė and Stasiškienė, 2021; Toro *et al.*, 2021). Moreover, numerous studies confirm the positive impact of the COVID-19 lockdowns on the concentration of the particulate matter in the air as well (Berman and Ebisu, 2020; Filonchyk *et al.*, 2021; Fu *et al.*, 2020; Ju *et al.*, 2021; Skirienė and Stasiškienė, 2021; Toro *et al.*, 2021).

However, the reductions in people's mobility and economic activity as the main constraints related to the COVID-19 pandemic have not always led to decreased particulate matter. For instance, the research focusing on the province of Ontario in Canada indicates that particulate matter did not show any significant reductions during the 'state of emergency, which was announced on March 17, 2020, and accompanied by the introduction of province-wide policy restrictions (Adams, 2020). The conditions were like those applied in many other countries, and they included, in the first place, the closure of schools, day-cares, libraries, restaurants, and bars (excluding take-out and delivery), and theatres (Adams, 2020). In the following days, the policy restrictions also included the closure of non-essential businesses and all outdoor recreational facilities and the limiting of public gatherings to five persons (Adams, 2020).

Given the scale of the policy restrictions imposed in Ontario, it cannot be taken for granted that the implementation of restrictive lockdown measures leads to a reduced concentration of particulate matter in the air. Similar conclusions can also be drawn from two other studies. The first one investigates the change in air quality in 20 cities on six continents, located in the most hard-hit countries by the COVID-19 pandemic during the spring of 2020 (Fu *et al.*, 2020).

The study indicates that the pandemic lockdowns led to a decrease in PM<sub>10</sub> 'in all the cities, except in Seoul and Los Angeles (insignificant increases), with the maximum decrease in Delhi (-45.9%) relative to 2019' (Fu *et al.*, 2020). The decreases were statistically significant in 9 of 19 cities relative to PM<sub>10</sub> concentrations in 2019.

In the second of the studies mentioned above, Briz-Redón *et al.* (2021) investigate the impact of the COVID-19 lockdown on the concentration levels of PM<sub>10</sub> and other pollutants over 11 large Spanish cities. The lockdown in Spain lasted from March 15 to April 12, 2020. According to Briz-Redón *et al.*, 'significant reductions of PM<sub>10</sub> levels were found during lockdown mainly and more clearly in three cities, Barcelona,

Valencia, and Sevilla, although Barcelona did not show significant decreases. In the rest of the cities, the differences in PM10 concentrations before and during the lockdown were not substantial.

Regarding air pollution in Poland, Filonchyk *et al.* (2021) investigate the effect of the COVID-19 lockdown (March-May 2020) on air quality in 5 large Polish cities, Gdansk, Krakow, Lodz, Warsaw, and Wroclaw. The study covers particulate matter (PM2.5 and PM10), NO<sub>2</sub>, and sulphur dioxide (SO<sub>2</sub>). The results show that, in most cases, the concentrations of pollutants in the air in 2020 were lower compared to 2019.

However, some cities experienced an increase in pollutants concentration during the spring of 2020, especially in March (but it needs to be noted that the air quality was investigated during the entire month, and the lockdown measures have been implemented since March 16, 2020). For instance, in March 2020, there was a substantial increase in PM10 concentration in Gdansk (64.2%) and Warsaw (17.2%) compared to the same period in 2019. In the following months (i.e., April and May), 'there was a significant reduction of all pollutants, except for SO<sub>2</sub>, compared to the previous years.

The greatest reductions of PM2.5 were registered in Wroclaw in April (-18.9% and -24.7%) and May (-31.2% and -21.1%), Lodz in April (-14.7% and -26.4%) and May (-16.3% and -20.7%) as compared to 2018 and 2019' (Filonchyk *et al.*, 2021). Nevertheless, Filonchyk *et al.* (2020; 2021), as well as other researchers such as Bherwani *et al.* (2020), Chen *et al.* (2020), and Wang and Su (2020), indicate that the significant reductions in air pollutants had a short-term effect. The emissions increased again, together with the gradual increases in the mobility of people and economic activity after lockdown.

As the literature review indicates, the studies that have been conducted so far have analysed whether the concentration of pollutants in the air decreased during the national lockdowns. In most cases, the positive impact of the lockdowns on air quality was confirmed. Nevertheless, as the lockdowns were short-term events, their long-term effects on air quality remained questionable.

This study investigates the influence of the COVID-19 lockdowns on air quality in a longer perspective and from the point of view of the necessity to comply with the obligations arising from Poland's membership in the EU. Namely, it aims to investigate whether the potential short-term improvement of air quality-related to lockdowns influenced the level of Poland's compliance with the air quality standards contained in the EU directives. Additionally, the study intends to investigate the impact of the Covid-19 pandemic on the AQ policy in Poland.

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### 3. Results and Discussion

#### 3.1 The Impact of the COVID-19 Pandemic on the Level of Poland's Compliance with the EU's Air Quality Directives

The EU is trying to tackle air pollution in two ways, by setting (1) concentration limit values of pollutants for ambient air and (2) standards for the sources of pollutants emission. The history of EU regulations on the concentration of pollutants in ambient air dates to the beginning of the 1980s. The first pollutant for which the concentration limit was established at the EU level was SO<sub>2</sub> (Directive 80/779/EC). Afterward, other regulations have followed, covering more air pollutants, and updating their concentration limit values (directives: 82/884/EEC, 85/203/EEC, 92/72/EEC, 96/62/EC, 1999/30/EC, 2000/69/EC, 2002/3/EC, 2004/107/EC).

At present, the standards for concentrations of pollutants that pose the most severe threat to human health and life are regulated by Directive 2008/50/EC on ambient air quality and cleaner air for Europe. The directive obliges the EU member states to monitor air quality continuously, specifying the minimum number of measurement points and their distribution. The data on individual pollutants from all the measurement points are transferred to the European Commission (EC) and the European Environment Agency (EEA). In the event of exceeding the pollutants' concentration limits by a given member state, the state must develop an air quality program that contains measures to meet the limit values as soon as possible. Next, the EC assesses the program, which can take legal action if it considers that the member state in question fails to comply with the directive.

When it comes to Poland, the EC noted the recurring problem of excessive concentration of PM<sub>10</sub>. Faced with no improvement, the EC decided to refer the case related to PM<sub>10</sub> infringement in Poland to the European Court of Justice (ECJ). Finally, on February 28, 2018, the ECJ ruled that Poland has failed to fulfil its obligations under Directive 2008/50/EC for the following reasons: (1) the daily limit values for PM<sub>10</sub> concentrations were exceeded; (2) no appropriate measures have been incorporated in ambient air quality programs to ensure that the exceedance period of PM<sub>10</sub> concentrations limit values is kept as short as possible; (3) Article 23(1) of Directive 2008/50/EC was not correctly implemented (ECJ, 2018). The judgment of the ECJ increased the pressure on the Polish government to improve air quality. However, the problem of air pollution remained unsolved, and, until the outbreak of the COVID-19 pandemic, the EU's limit values for PM<sub>10</sub> concentrations were exceeded.

As the excessive concentration of PM<sub>10</sub> constitutes the main problem of poor air quality in Poland, this study aims to verify the impact of the restrictive policy measures imposed due to the pandemic on the potential reduction of PM<sub>10</sub> concentration in Poland throughout 2020. The effect is evaluated in terms of a daily limit value for PM<sub>10</sub> concentrations. According to Directive 2008/50/EC, the daily

limit value is  $50 \mu\text{g}/\text{m}^3$ , and it must not be exceeded more than 35 times in a calendar year. The research covers 72 air quality measurement areas, in which the daily limit value was exceeded more than 35 times in 2019. The data were retrieved from automatic and manual air quality monitoring stations (CIEP, 2021a). Daily mean concentrations of PM<sub>10</sub> were obtained using hourly data averaging. The research is conducted about the year preceding the pandemic.

The research results show that, in 2020, the number of days when the concentration of PM<sub>10</sub> exceeded  $50 \mu\text{g}/\text{m}^3$  decreased in the case of almost all the measurement stations under consideration (93%). Consequently, in 35 out of 72 stations (48,6%), the threshold of 35 days in a calendar year with a daily average of more than  $50 \mu\text{g}/\text{m}^3$  was no longer exceeded. This should be regarded as a considerable improvement of air quality in Poland from the point of view of the EU's PM<sub>10</sub> concentration limits.

However, the COVID-19 pandemic should not be considered the only factor influencing the improved air quality in Poland in 2020. The analysis of the average yearly concentration of PM<sub>10</sub> in the years 2016-20 indicates that PM<sub>10</sub> concentration increased in Poland in the years 2016-18 and afterward started to decrease (CIEP, 2021b). In addition, the decrease observed in 2019 about 2018 was even more significant than the decrease in 2020 about 2019. This indicates that the air quality improvement in 2020 should be considered as the consequence of the policy restrictions (lockdown) related to the COVID-19 pandemic and the result of the gradually implemented AQ policy measures.

### **3.2 The Impact of the COVID-19 Pandemic on the AQ Policy in Poland**

Air pollution is called the silent killer, as the concentration of hazardous pollutants to human health is usually not perceptible to human senses. This 'invisibility of the air pollution problem has not been conducive to the development of AQ policy, and – from a historical perspective – the problem needed to become visible to stimulate the policy development. This has been aptly observed by Monks and Williams (2020), who introduced a two-stage model of AQ policy development. The model is based on historical data on Europe and the United States (US). It indicates that 'there are two phases to air quality mitigation, the first driven by the air quality emergency as the pollution is visible and the effects can be relatively obvious.

The second is driven by science directed towards continuous improvement' (Monks and Williams, 2020). In the case of Europe and the US, the first stage of the development of AQ policy was conditioned by: (1) intensified smog events in Los Angeles in the 1940s and 1950s, including the smog that occurred in July 1943, as well as (2) the equivalent of this event in Europe, i.e., the Great Smog in London in December 1952. Even though both crises could be regarded as episodic, their persistence, public visibility, and undeniable negative health effects drove policy responses in the form of the UK Clean Air Act (in 1956) and the US Clean Air Act (in 1963). After this 'emergency phase' of AQ policy development, the policy has

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been increasingly driven by new scientific findings ('science phase') rather than 'emergencies' (Monks and Williams, 2020).

The research conducted by Monks and Williams indicates how important it was for the development of AQ policy to 'visualize' air pollution and create public awareness of the threat posed to human health by polluted air. In Poland, air pollution has been treated as almost non-existent for a long time (excluding some regional exceptions), and, in consequence, the public awareness of poor air quality over most of the country's territory has been deficient. This 'invisible' problem was made visible thanks to the actions undertaken by the EC and the EEA. However, these actions took place only in the second decade of Poland's membership in the EU.

Two events considerably raised public awareness of the pollution problem in Poland. Firstly, in November 2017, the EC and the EEA launched a new online service, the European Air Quality Index, that provided information on current air quality across Europe. The importance of the service was related to the fact that it presented data on air pollution from a comparative European perspective, and the quality of the air was described as poor as soon as the concentration limit of a given pollutant was exceeded. In consequence, the service visualized the problem of poor air quality in Poland. It drew the attention of Polish citizens to the fact that Poland belonged to the most polluted countries in Europe.

The second event that helped raise public awareness of poor air quality was related to the decision of the EC to refer the case of Poland regarding PM10 infringement to the ECJ. The judgment of the ECJ turned out to be the factor that strongly activated social organizations involved in air pollution in the country. It also made individual citizens start filing lawsuits against the State Treasury to demonstrate that air pollution constituted a severe problem in Poland. Public authorities should have solved the problem.

To sum up, the launch of the European Air Quality Index and the judgment of the ECJ related to high PM10 concentration made air pollution in Poland visible and thus increased social pressure to solve it. Referring to the previously described model developed by Monks and Williams, these events turned out to be the 'emergency phases' of Poland's AQ policy development. Unfortunately, the policy development that followed those events overlapped with the crisis triggered by the COVID-19 pandemic.

The scale of the COVID-19 crisis appears to be enormous. As we know from experience, an emerging problem, as a source of various types of threats, initially calls for actions from persons responsible for overcoming it (i.e., politicians and other decision-makers) to ensure the primary need – maintaining safety. In this regard, Rhinard (2019) reminds us that a policy that reacts to a crisis, combined with the regular monitoring of potential new areas affected by the problem (such as recent threats), displays a tendency to crowd out the policy, which requires deeper

democratic deliberation. Consequently, it is not surprising that Poland's policy as a COVID-19 crisis response tended to pull out actions aimed at reducing air pollution. In addition, the unexpected improvement of air quality due to the pandemic lockdowns has relieved the pressure on the country's authorities to implement measures that would potentially improve air quality in the long term.

However, it is worth noting that the latest studies indicate a negative influence of air pollution on the development of the COVID-19 pandemic (Conticini *et al.*, 2020; Toczyłowski *et al.*, 2021; Travaglio *et al.*, 2021). For instance, Toczyłowski *et al.* (2021) found an exponential relationship between cumulative particulate matter pollution and the incidence of COVID-19 and other respiratory infections; the association remained significant after adjusting for air temperatures and a long-term trend. For this reason, all the measures that can decrease particulate matter concentrations should be seen as tools to prevent the spread of the COVID-19 pandemic. Nevertheless, the problem concerning the relationship between particulate matter pollution and the incidence of COVID-19 has not been raised in the public debate in Poland. The underlying logic is that if the government wanted to carry out radical reforms to improve Poland's air quality, it would most likely use the above argument to support such actions. In the case of Poland, the most urgent reforms should include a shift from the use of coal to cleaner (preferably renewable) energy sources, as the main reason for air pollution is the combustion of coal and other fossil fuels.

The research sheds new light on this issue on the success and failure of public policies tied to crisis management theories. As McConnell (2011) states, following a well-traveled road generates a sense of lowering the risk of loss, and reaching for new solutions increases it. In Poland, the potential coal mining reforms are socially sensitive issues, and there is no doubt that it would not be easy to achieve political success in this field. For this reason, namely the fear of failure, the political elites may postpone undertaking reforms in this area and focus on problems more directly related to the COVID-19 pandemic instead.

#### **4. Conclusions**

In Poland, the COVID-19 lockdowns led to a considerable improvement in air quality and thus positively influenced Poland's compliance with the EU's air quality standards. In 2019, there were 72 air quality measurement stations, in case of which the threshold of 35 days in a calendar year with a daily average concentration of PM10 above 50  $\mu\text{g}/\text{m}^3$  was exceeded. In 2020, 48,6% of those stations managed not to exceed the limit mentioned above. However, the unexpected reduction of air pollution relieved the country's authorities' pressure to implement reforms to improve air quality. In addition, the policy responding to the COVID-19 crisis in Poland tended to crowd out other approaches, particularly those that required deeper democratic deliberation, and the AQ policy was not an exception to this rule.

To sum up, even though the impact of the COVID-19 pandemic on air quality in Poland is positive, the effect of the pandemic on the country's AQ policy should be regarded as harmful. It is even more so considering that the COVID-19 crisis has not changed the EU's priorities when it comes to AQ policy. For instance, on May 12, 2021, the EC published communication that set out its 'Zero Pollution Action Plan' in the framework of the European Green Deal (EC, 2021). This action plan contains mid-term targets to be achieved by 2030. As regards air pollution, the EU's target is to reduce premature deaths associated with air pollution by at least 55%. In other words, if Poland wants to participate in achieving such ambitious goals, air quality reforms should not be postponed but should be given high priority instead.

### References:

- Adams, M.D. 2020. Air pollution in Ontario, Canada during the COVID-19 State of Emergency. *Science of the Total Environment*, 742, 1405-16.
- Berman, J.D., Ebisu, K. 2020. Changes in U.S. air pollution during the COVID-19 pandemic. *Science of the Total Environment*, 739, 139864.
- Bherwani, H., Nair, M., Musugu, K., Gautam, S., Gupta, A., Kapley, A., Kumar, R. 2020. Valuation of air pollution externalities: comparative assessment of economic damage and emission reduction under COVID-19 lockdown. *Air Quality, Atmosphere & Health*, 13, 683-694.
- Briz-Redón, Á., Belenguer-Sapiña, C., Serrano-Aroca, Á. 2021. Changes in air pollution during COVID-19 lockdown in Spain: A multi-city study. *Journal of Environmental Sciences* 101, 16-26.
- Chen, Q.X., Huang, C.L., Yuan, Y., Tan, H.P. 2020. Influence of COVID-19 event on air quality and their association in Mainland China, *Aerosol and Air Quality Research* 20, 1541-1551.
- Chief Inspectorate for Environmental Protection (CIEP). 2021a. Retrieved from: <https://powietrze.gios.gov.pl/pjp/archives>.
- Chief Inspectorate for Environmental Protection (CIEP). 2021b. Wpływ ograniczeń gospodarczych związanych z pandemią Covid-19 na wysokość stężeń zanieczyszczeń powietrza w 2020 roku (The impact of economic constraints related to the Covid-19 pandemic on the concentration of air pollutants in 2020), Warszawa.
- Conticini, E., Frediani, B., Caro, D. 2020. Can atmospheric pollution be considered a co-factor in extremely high level of SARS-CoV-2 lethality in Northern Italy? *Environmental Pollution*, 261, 114465.
- European Commission (EC). 2021. EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil', COM (2021) 400.
- European Court of Justice (ECJ). 2018. Judgment of the Court (Third Chamber) of 22 February 2018 - European Commission v Republic of Poland, OJ C 134/6.
- Filonchik, M., Hurynovich, V., Yan, H. 2021. Impact of Covid-19 lockdown on air quality in the Poland, Eastern Europe. *Environmental Research*, 198, 110454.
- Filonchik, M., Peterson, M. 2020. Air quality changes in Shanghai, China, and the surrounding urban agglomeration during the COVID-19 lockdown. *Journal of Geovisualization and Spatial Analysis*, 4(2), 1-7.
- Fu, F., Purvis-Roberts, K.L., Williams, B. 2020. Impact of the COVID-19 Pandemic Lockdown on Air Pollution in 20 Major Cities around the World, 11(11), 1189.

- Ghahremanloo, M., Lops, Y., Choi, Y., Mousavinezhad, S. 2021. Impact of the COVID-19 outbreak on air pollution levels in East Asia. *Science of the Total Environment*, 754, 142226.
- He, G., Pan, Y., Tanaka, T. 2020. The short-term impacts of COVID-19 lockdown on urban air pollution in China. *Nature Sustainability*, 3, 1005-1011.
- Higham, J.E., Acosta Ramírez, C., Green, M.A., Morse, A.P. 2021. UK COVID-19 lockdown: 100 days of air pollution reduction? *Air Quality, Atmosphere and Health* 14, 325-332.
- Ju, M.J., Oh J., Choi, Y.H. 2021. Changes in air pollution levels after COVID-19 outbreak in Korea. *Science of the Total Environment*, 750, 141521.
- Krecl, P., Targino, A.C., Oukawa, G.Y., Cassino Junior, R.P. 2020. Drop in urban air pollution from COVID-19 pandemic: Policy implications for the megacity of São Paulo, *Environmental Pollution*, 265, 114883.
- McConnell, A. 2011. Success? Failure? Something in-between? A framework for evaluating crisis management. *Policy and Society*, 30, 63-76.
- Monks, P.S., Williams, M.L. 2020. What does success look like for air quality policy? A perspective, *Philosophical Transactions of the Royal Society A* 378, 20190326.
- Rhinard, M. 2019. The Crisisification of Policymaking in the European Union. *Journal of Common Market Studies*, 57(3), 616-633.
- Shehzad, K., Sarfraz, M., Shah, S.G.M. 2020. The impact of COVID-19 as a necessary evil on air pollution in India during the lockdown. *Environmental Pollution*, 266, 115080.
- Skirienė, A.F., Stasiškienė, Ž. 2021. COVID-19 and Air Pollution: Measuring Pandemic Impact to Air Quality in Five European Countries, *Atmosphere*, 12(3), 290.
- Toczyłowski, K., Wietlicka-Piszczyk, M., Grabowska, M., Sulik, A. 2021. Cumulative Effects of Particulate Matter Pollution and Meteorological Variables on the Risk of Influenza-Like Illness. *Viruses*, 13, 556.
- Toro, R.A., Catalána, F., Urdanivia, F.R., Rojas, J.P., Manzano, C.A., Seguel, R., Gallardo, L., Osses, M., Pantoja, N., Leiva-Guzman, M.A. 2021. Air pollution and COVID-19 lockdown in a large South American city: Santiago Metropolitan Area, Chile. *Urban Climate* 36, 100803.
- Travaglio, M., Yu, Y., Popovic, R., Selley, L., Leal, N.S., Martins, L.M. 2021. Links between air pollution and COVID-19 in England. *Environmental Pollution*, 268, 115859.
- Venter, Z.S., Aunan, K., Chowdhury, S., Lelieveld, J. 2020. COVID-19 lockdowns cause global air pollution declines. *Proceedings of the National Academy of Sciences of the United States of America*, 117(32), 18984-18990.
- Wang, Q., Su, M. 2020. A preliminary assessment of the impact of COVID-19 on environment - A case study of China, *Science of The Total Environment*, 728, 138915.