

Public Awareness of Air Pollution and Mitigation of Its Risk

Endah Saptutyningsih¹, Berli Paripurna Kamiel²

¹ Faculty of Economics and Business, Universitas Muhammadiyah Yogyakarta, Indonesia

² Faculty of Engineering, Universitas Muhammadiyah Yogyakarta, Indonesia

Article Info

Keywords:

Abstract

Purpose: This Community Partnership Program (PKM) aims to increase public awareness about the negative impacts of air pollution and how to mitigate it.

Methodology: handing over air pollution monitoring tools, counseling, and planting air pollution-reducing plants.

Results: the presence of counseling can increase understanding of the negative impacts of air pollution. Public awareness to mitigate the negative impact of air pollution has increased after attending counseling. For mitigating the negative impact of air pollution, the community will plant air pollution-reducing plants, service routinely their vehicle and reduce the use of vehicles.

Applications/Originality/Value: This community service program is based on the results of air pollution mapping in the city of Yogyakarta. Programs to raise public awareness about health risks due to air pollution are still rare in Yogyakarta and the importance of knowledge about ways to mitigate air pollution risks.

1. INTRODUCTION

In addition to be an increasingly significant problem, air pollution is a major concern in numerous fields, such as the environment, health, economy, and politics. In the literature, there are many definitions of air pollution (Devinny, Deshusses & Webster, 1998; Güney, 2004; Flagan & Seinfeld, 2013; Özey, 2009). Air pollution in general can be defined as the increase in the rate of harmful gases and particles in the atmosphere, combining these definitions (Özey, 2009). This rise harms living standards. For example, in 2012, millions of people lost their lives due to air pollution-related causes, according to the World Health Organization (WHO). It can also be said

that while air pollution harms human health and other living organisms (Oanh et al., 2006), it also harms historical objects, technical devices, and buildings (Hyslop, 2009; Paulos, Honicky & Goodman, 2007; Ridker & Henrick, 1967). Also, as it creates economic and legal problems for countries (Selden & Song, 1994; Best & Collins, 1982; Rothbard, 1982), air pollution emergency steps must be taken.

Economic activities that run fast require urban transportation facilities. Economic growth, which is marked by an increase in per capita income, will increase the people's purchasing power of motorized vehicles as a means of transportation. Various types of transportation,

especially motorized vehicles, crowd urban streets as the center of economic activity (central business district). This phenomenon also occurs in the province of Yogyakarta Special Region where there are many trade and education centers that support the regional economy. In Yogyakarta City, the CO concentration of carbon monoxide is still below the quality standard threshold, however, when compared to the three previous districts, the CO concentration is still higher. The CO concentration in Yogyakarta City ranges from 3-11 ppm. This higher CO concentration may be due to the higher number of vehicles in Yogyakarta City than in the other three districts, namely Bantul, Kulon Progo, and Gunung Kidul (Basuki & Saptutyningsih, 2012). The result of air pollution by carbon monoxide (CO) is an increase in people with ARI (Acute Respiratory Infection). For this purpose, to reduce air pollution and bring its negative effects, various studies are conducted to assess the current situation and determine the possible steps to be taken (e.g. KYOTO Protocol, 1997; Paris Convention, 2015). Improving the educational level and raising environmental awareness is essential for reducing air pollution (Selden & Song 1994). There is still low public awareness of maintaining air quality due to the lack of knowledge about the negative impacts of air pollution on health and a lack of understanding of ways to mitigate the risk of air pollution. Therefore, this Community Partnership Program (PKM) activity aims to increase public awareness about the negative impacts of air pollution and how to mitigate it.

Based on the results of monitoring the concentration of carbon monoxide gas (CO) pollutants in four districts and the city of Yogyakarta, using the Kriging technique it was found that the areas with the highest CO concentrations were in the city of Yogyakarta including the districts of Jetis, Gondomanan, Tegalrejo, Kraton, Mantrijeron, some Ngampilan, Gedongtengen, and Mergangsan (Basuki & Saptutyningsih, 2012). A large number of centers of economic activity and other public facilities demand a means of transportation that produces motor vehicle exhaust emissions, where CO gas is one of the products of motor vehicle exhaust. Also, the combustion products produced by industries can cause high CO concentrations in

the region. The high exhaust gas from motorized vehicles and combustion products which are not matched by the presence of green open space (RTH) causes the CO concentration in Yogyakarta to be relatively high. This can be shown in Figure 1, wherein the city of Yogyakarta, green open spaces are rarely found.

Based on the results of air pollution mapping, the area that has the highest CO concentration is in the city of Yogyakarta, one of which is Tegalrejo. The road conditions in Tegalrejo, especially RW 07, are dominated by asphalt roads, as well as small roads that have been installed with blocks to support the activities of residents, most of whom have private motorized vehicles. One household even owns more than one motor vehicle. Based on the observations, RW 07 Tegalrejo has regular meetings every month. This meeting can be used as an outreach for residents about the importance of mitigating the negative impact of air pollution on health. The presence of air pollution monitoring tools may cause people to realize the importance of reducing air pollution. Likewise, based on the observations, there are still rare plants that can reduce air pollution, which can also be used as ornamental plants in every household or the garden.

Some of the problems experienced by the community based on our observations are: 1) Most of the RW 07 community has a private motorized vehicle with a densely-built environment without any air pollution monitoring device that can encourage people to be aware of reducing air pollution; 2) Lack of public awareness of the impact of air pollution, especially from motorized vehicles and the importance of mitigating the negative impacts of air pollution; 3) Lack of public awareness of motorized vehicle owners to perform routine servicing to clean motor vehicle exhausts; 4) There has been no effort to mitigate the negative impact of air pollution in RW 07 Tegalrejo, Yogyakarta.

This Community Partnership Program (PKM) is aimed at detecting the content of air pollution and increasing public awareness to mitigate the negative impact of air pollution on public health. This community partnership program will raise awareness of the importance

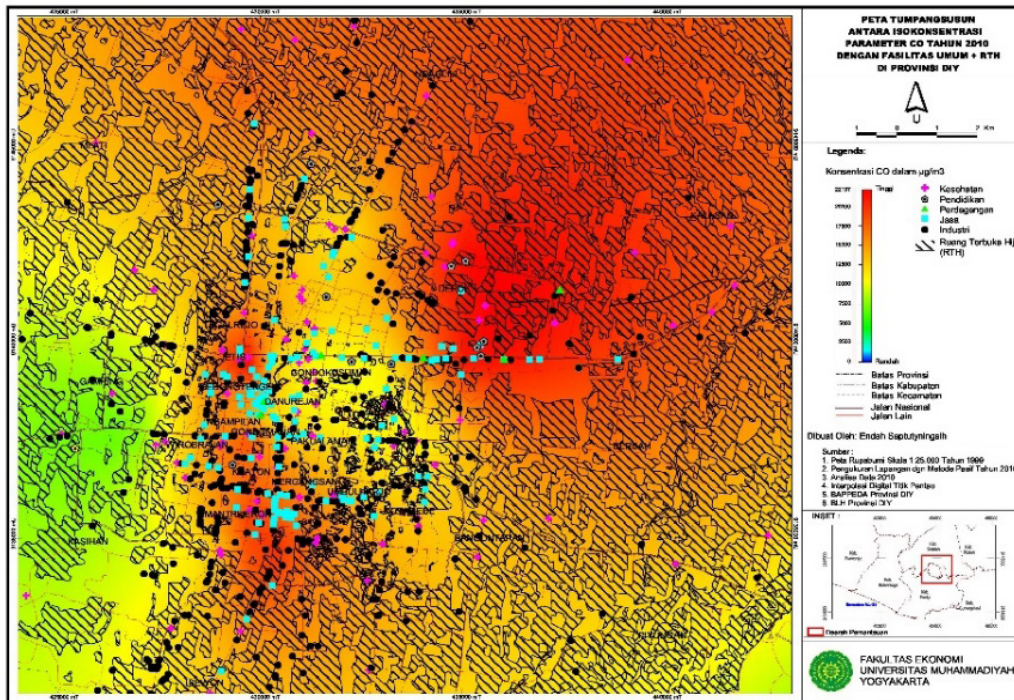


Figure 1 Overlay Map between Isoconcentration of CO Parameters with Public Facilities and Green Open Space in areas with the highest CO concentration in DI Yogyakarta province.

of mitigating the impact of air pollution by conducting counseling and planting plants to reduce pollutant emissions in the air. The program also donates pollutant detectors which may be used to measure the carbon monoxide pollution in the RW 7 area regularly.

2. METHODS

The high level of economic activity demands transportation facilities. The economic growth, which is marked by an increase in per capita income, will increase the people’s purchasing power of motorized vehicles as a means of transportation. The use of motorized vehicles harms public health and reduces environmental comfort. Based on the results of research by Agus & Saptutyingsih (2012), it is concluded that Tegalrejo is one of the areas that have a high level of carbon monoxide (CO) pollution. Mitigation of the negative impact of air pollution on public health needs to be done based on local wisdom to support government programs in improving public health and environmental management in a good and sustainable manner.

Based on observations and mapping results of air pollution, density of buildings and high

levels of carbon monoxide (CO) pollution and a lack of public awareness to mitigate the negative impacts of air pollution, it encourages the PKM program Action Plan as follows:

Use of an air pollution monitoring device (gas analyzer)

To monitor the level of carbon monoxide (CO) pollution in RW 07, Tegalrejo, a gas analyzer will be installed. The device makes the residents know how high the CO level is in the area where they live.

Counseling

To increase public awareness, especially the community of RW 07 Tegalrejo, Yogyakarta about the negative impacts of air pollution, the Community Partnership Program provides counseling to mitigate the negative impacts of air pollution on health. Besides, by reducing air pollution, energy consumption, especially motor vehicle fuel, can be saved. Energy efficiency can directly improve people’s welfare.



Figure 2 Gas Analyzer Tool

Planting Sansevieria to reduce air pollution

To support the series of activities of the Community Partnership Program, one of the efforts to mitigate air pollution in the area of RW 07, Tegalrejo, is to promote the planting of Sansevieria plants to reduce air pollution, especially carbon monoxide (CO). Adawiyah et al (2013) showed that Sansevieria plants were one of the plants that could reduce air pollution. RW 07 people will get the plant and it is hoped that it can be bred in their respective homes as well as in gardens in the RW 07 area of Tegalrejo, Yogyakarta. With the mass planting of this plant, it is hoped that the level of air pollution in RW 07 Tegalrejo can be reduced, and indirectly can improve public health so that people's welfare increases.

3. OUTPUT RESULTS

Handover of air pollution monitoring equipment

To increase public awareness of the importance of mitigating the negative impact of air pollution on health and fuel savings, the Community Partnership Program implementation team has donated 5 units of gas analyzers which will be distributed to 5 RTs under the auspices of RW 7, Tegalrejo. The handover of goods grants was represented by the Chairperson of RW 7 of Tegalrejo, Yogyakarta on Monday, July 27, 2020, at the residence of the Chairman of RW 7, Tegalrejo. The use of this gas analyzer is to determine the level of air pollution, especially carbon monoxide (CO) gas, which is one of the pollutants generated from motorized vehicle exhaust gases in the RW 07 Tegalrejo and its surroundings and mitigates the impact of air pollution in the region.



Figure 3 Handover of gas analyzer goods grants with the Head of RW 7 Tegalrejo, Yogyakarta City

Submission of air pollution-reducing plants

The handover of the sansevierias plant was carried out to the RW Chairman on Sunday, July 26, 2020. The planting of this plant is intended to reduce air pollution produced by motorized vehicles in the area of RW 7, Tegalrejo, Yogyakarta.

Also, a questionnaire has been prepared which will be distributed to community members of RW 07 Tegalrejo Yogyakarta regarding the importance of mitigating the risk of air pollution due to motorized vehicles and energy efficiency. This questionnaire consists of two types, namely those distributed before online counseling and after online counseling. This questionnaire is distributed through the online WhatsApp media using the following google form link:

<http://bit.ly/Sebelum-Penyuluhan-Dampak-P-Revolusi>

<http://bit.ly/Setelah-Penyuluhan-Dampak-P-Pollution>

In addition to preparing a questionnaire in the form of a google form, due to the COVID-19 pandemic conditions that do not allow large groups of people, the PKM implementer made video information about the impact of air pollution and mitigation methods which would be distributed to residents of RW 07, Tegalrejo to be followed as a substitute for face-to-face counseling. The counseling video is uploaded on social media, namely Youtube with the following link:

<https://www.youtube.com/watch?v=u6NM0vgpgAk>

Online counseling

After filling out the questionnaire before counseling, the PKM Implementation Team top up the residents' mobile phones who had filled out the questionnaire as a substitute for meals since the counseling was carried out online via Youtube. The credit is used by residents to open and follow counseling via Youtube and then fill out a google questionnaire form after counseling. The offline counseling was given to RT administrators, which numbered approximately 12 people, and online via youtube media which was witnessed by RW 7 residents individually by giving questionnaires via google form before and after counseling which could be accessed by these residents.

The RT administrators in the RW 07 area of Tegalrejo distributed the youtube link that was given by the PKM implementation team to the respective RT residents with the link:

<https://www.youtube.com/watch?v=u6NM0vgpgAk>

Many views have watched an outreach video about the impact of air pollution and how to mitigate it. The video is uploaded on Youtube publicly so that not only the residents of RW 07 Tegalrejo will get insight into the impact of air pollution and ways of mitigating it, but also the wider community can benefit from this counseling.

Filling out the questionnaire before and after counseling

After all the materials and questionnaires were prepared, the PKM Implementing Team sent a questionnaire before counseling in the form of a google form to WhatsApp for each RT administrator in the RW 07 area of Tegalrejo. RT 25, 26, 27, 28, 32, and 46 administrators then distributed a google link questionnaire form before outreach to their residents to their respective RT groups with the link <http://bit.ly/Sebelum-Penyuluhan-Dampak-P-Revolusi>



Figure 4 Handover of air pollution reduction plant grants

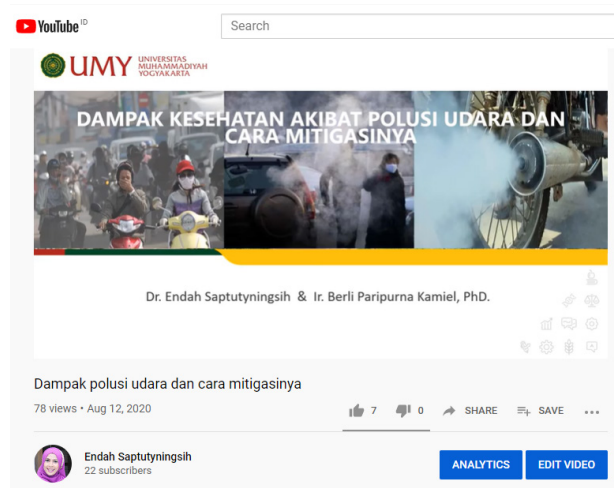


Figure 5 Counseling videos uploaded on Youtube

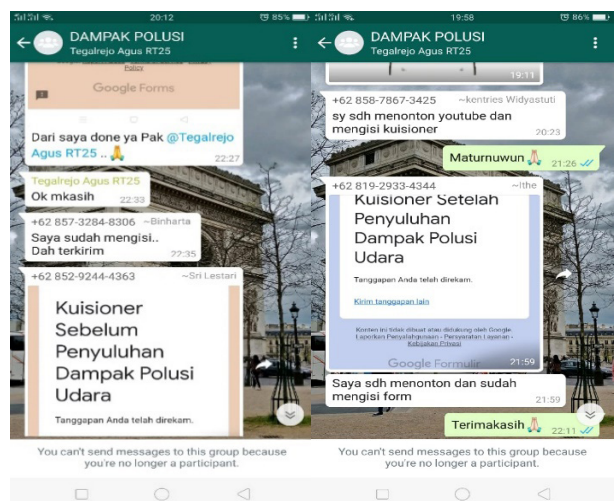


Figure 6 Views of the questionnaire before and after outreach that had been filled in by the residents

After residents take part in the online counseling, the PKM Implementation Team sends a google link to the questionnaire form after counseling to each RT head in the RW 07 area so that it is distributed to residents who have already received credit through their respective RT groups with the link: <http://bit.ly/After-Counseling-Impact-Pollution>

As many as 55 residents in RW 07, Tegalrejo, have filled out the questionnaire before the counseling that has been distributed on the WhatsApp group of each RT. The results of the questionnaire will be explained further.

Based on age, 42% of the participants were 41-50 years old, while the remaining 22% were 31-40 years old, 51-60 years old, and the rest less than 20 years and over 60 years old.

The participants based on sex consisted of 67.3% male and 32.7% female.

Based on marital status, participants were dominated by those who were married, namely as much as 81.8%, while the remaining 10.9% were unmarried and 7.3% were widows/widowers.

Table 1 Composition of participants by age

Age	Percentage
<= 20 years old	2
21-30 years old	5
31-40 years old	22
41-50 years old	42
51-60 years old	25
>= 60 years old	4

Table 2 Composition of participants by sex

Sex	Percentage
Male	32.7
Female	67.3

Table 3 Composition of participants by marital status

Marital status	Percentage
Unmarried	10.9
Married	81.8
Widower	7.3

Table 4 Composition of participants by education level

Education level	Percentage
Elementary school	5
Junior high school	4
Senior high school	64
Vocational	6
Graduated	20
Postgraduate	1

Table 5 The composition of participants based on knowledge of the impact of air pollution on health

Knowledge	Percentage	
	Before counseling	After counseling
Not know	9.1	5.5
Only hear but didn't know	32.7	24.3
Know but didn't mitigate the impact	40	24.3
Know and mitigate the impact	18.2	45.9

Table 6 The composition of participants based on knowledge of upper respiratory infection

Knowledge	Percentage	
	Before counseling	After counseling
Not Know	14.5	2.7
Know	85.5	97.3

According to the level of education, as many as 56.4% of the participants had a high school education/equivalent, 20% graduated 20%, while the rest had an elementary, junior high, D3, and other education.

According to knowledge about the impact of air pollution on health, with counseling, there was an increase in the number of participants who knew and had mitigated the negative impacts of air pollution, from 18.25 to 45.9% of all participants. The number of participants who only heard but did not know in detail the impact decreased from 32.7% to 24.3% of the participants. Thus, the existence of counseling

can increase participants' knowledge about the negative impacts of air pollution and the importance of mitigating these impacts.

Based on knowledge about Upper Respiratory Infection, after attending counseling, participants found out about ISPs increased from 85.5% to 97.3% of participants. This shows that the existence of counseling can increase knowledge about the health effects of air pollution in the form of upper respiratory infections.

With counseling, the number of participants who did not know about gas analyzers decreased from 70.9% to 21.6%. As many as 45.6% of participants already knew that there had been much improvement than before there was counseling. This shows an increase in the participants' knowledge of air pollution monitoring tools, namely gas analyzers, which are useful for monitoring air quality conditions in the surrounding environment.

Table 7 The composition of the participants was based on an understanding of the benefits of the Sansevieria plant

Knowledge	Percentage	
	Before counseling	After counseling
Not know	29.1	8.1
Only hear but didn't know	38.2	10.8
Know but didn't plant it	16.4	56.8
Know and have already planted it	16.4	24.3

Table 8 The composition of participants was based on knowledge of air pollution-reducing plants

Knowledge	Percentage	
	Before counseling	After counseling
Bougenville	16.4	8.1
Puring	9.1	2.7
Pucuk merah	21.8	0
True all	40	67.6
False all	12.7	21.6

Table 9 The composition of participants was based on the benefits of routine vehicle checks to reduce air pollution

Benefit	Percentage	
	Before counseling	After counseling
Yes	85.5	97.3
No	14.5	2.7

According to the knowledge about air pollution-reducing plants, after the extension, there was a significant increase in participants' understanding of the types of plants that can reduce air pollution from 40% to 67.6%. This illustrates an increase in public understanding of one way of mitigating air pollution by planting air pollution-reducing plants by knowing these types of plants.

The hope of the participants after attending the counseling on the health impacts of air pollution, after the counseling, there was an increase in the number of participants who would mitigate the negative effects of air pollution, both planting air pollution-reducing plants and servicing motor vehicles from 40% to 70.3%. Thus, an extension can increase public awareness about the importance of mitigating the negative impacts of air pollution.

With counseling, in general, all mitigation measures for the negative impacts of air pollution have increased both by planting air pollution-reducing plants, carrying out routine motorized service services, reducing motor vehicle use, installing filter devices in the exhaust, and choosing vehicles less than 10 years old. This shows that outreach can increase public awareness about the importance of mitigating the negative impacts of air pollution.

Counseling on how to use a gas analyzer

Counseling on how to use a monitoring device (gas analyzer) to RT administrators to find out the level of air pollution in the RW 07 area of Tegalrejo and its surroundings and monitoring by each RT regularly.



Figure 7 Counseling on using of a gas analyzer to RT administrators in the RW07, Tegalrejo

Based on the results of the meeting, the air pollution monitoring device, namely the gas analyzer, will be used in each RT in the RW 07 area of Tegalrejo. The plan is to conduct monthly monitoring to monitor air pollution conditions around the residence, especially carbon monoxide gas. Planting air pollution-reducing plants can also help reduce pollutant levels in the area of RW07, Tegalrejo, Yogyakarta.

4. CONCLUSION

Based on the PKM activity plan, mostly all of the planned activities have been carried out well. However, due to the COVID-19 pandemic condition, the method of implementation is different from the plan. There is a ban on gathering in large numbers, so several activities are carried out online to anticipate the spread of the virus. With the use of the google facility, the questionnaire form to be filled in by RW 07 residents before and after counseling has been attended by representatives of each RT citizen. Counseling about the impact of air pollution and ways of mitigating it is also carried out online via a Youtube link and has been watched by around

78 views until August 20, 2020. The purpose of this extension is to increase people's knowledge about the importance of maintaining air quality in the surrounding environment and the need to mitigate the negative impacts of air pollution and besides the need for energy efficiency. Based on the results of the questionnaire before and after online counseling, in general, there was an increase in public knowledge regarding the negative impacts of pollution and ways of mitigating it, both by planting reducing plants and by reducing motor vehicle use and servicing motorized vehicles which at the same time could increase energy or fuel-efficiency. Besides, the understanding of air pollution monitoring equipment in the form of a gas analyzer has also increased. Participants realized the importance of air pollution monitoring tools and mitigated this by planting air pollution-reducing plants in the surrounding environment. Another activity that was also carried out in this PKM was the handover of air pollution monitoring tools, especially carbon monoxide gas and air pollution-reducing plants. The monitoring tool has been received by the management of each RT and will be monitored regularly in their respective areas. Planting air pollution-reducing plants has been carried out to improve air quality in the area of RW07, Tegalrejo, Yogyakarta. This PKM activity hopes to increase public awareness about the negative impacts of air pollution, the importance of clean air quality, and ways to mitigate the negative impacts of air pollution as well as the importance of energy efficiency to maintain clean air quality so that public health improves.

5. ACKNOWLEDGMENT

The implementation team of the Community Partnership Program (PKM) would like to thank LP3M UMY for providing Community Service Grants in 2020 so that this PKM activity can be carried out. Likewise, thanks are conveyed to the Chairman of RW 07 along with RT management and community members in the area of RW 07, Tegalrejo, Yogyakarta City who have participated in this PKM activity.

REFERENCES

- Adawiyah, A.R., Arindita, N.D., Selviastuti, R., Yuliawati, S. 2013. Panda Sansevieria (Pengharum Ruangan Anti Debu dan Asap Rokok Dengan Sistem Penetralisir Sirkulasi Udara). *Jurnal Ilmiah Mahasiswa*, Vol. 3 No.1.
- Badan Pusat Statistik. 2017. *Kecamatan Tegalrejo dalam Angka*. BPS Kota Yogyakarta.
- Basuki, A.T. & Saptutyningasih, E. 2012. Pemetaan Polusi Udara Perkotaan di Propinsi Daerah Istimewa Yogyakarta. *UNISIA*, Vol. XXXIV No. 76 Januari 2012.
- Best, R. K. and Collins, J. I. (1982). Legal Issues in Pollution-Engendered Torts. *Cato Journal*, 2(1), 101-136.
- Devinny, J.S., Deshusses, M.A. and Webster, T.S. (1998). *Biofiltration for Air Pollution Control*. Newyork: Lewis Publishers
- Flagan, R. C. and Seinfeld, J. H. (2013). *Fundamentals of Air Pollution Engineering*. New Jersey. Courier Corporation.
- Güney, E. (2004). *Geography of Environmental Issues*. Ankara: Gündüz Eğitim ve Yayıncılık
- Hyslop, N.P. (2009). Impaired visibility: The air pollution people see. *Atmospheric Environment*, 43(1), 182-195.
- Nurfathiyah, P., Mara, A. . Siata, R, Farida, A. dan Aprillita. 2011. Pemanfaatan Video Sebagai Media Penyebaran Inovasi Pertanian. *Jurnal Pengabdian pada Masyarakat*, No. 52, pp. 30-35, 201114.
- Oanh, N. K., Upadhyay, N., Zhuang, Y. H., Hao, Z. P., Murthy, D. V. S., Lestari, P., Villarin, J.T., Chengchua, K., Co, H.X., Dung, N.T. and Lindgren, E. S. (2006). Particulate air pollution in six Asian cities: Spatial and temporal distributions, and associated sources. *Atmospheric Environment*, 40(18), 3367-3380.
- Özey, R. (2009). *Environmental Issues*. İstanbul: Aktif Yayınevi.
- Paulos, E., Honicky, R. J. and Goodman, E. (2007). Sensing atmosphere. ACM Conference on Embedded Networked Sensor Systems (SenSys 2007) 6–9 November 2007 in (p. 203-206), Sydney
- Ridker, R. G. and Henning, J. A. (1967). The determinants of residential property values with special reference to air pollution. *The Review of Economics and Statistics*, 49(2), 246-257.
- Rothbard, M. N. (1982). Law, property rights, and air pollution. *Cato Journal*, 2, 55. Cited from: <http://heinonline.org/HOL/LandingPage?handle=hein.journals/catoj2&div=8&id=&page=>
- Selden, T. M. and Song, D. (1994). Environmental quality and development: Is there a Kuznets curve for air pollution emissions? *Journal of Environmental Economics and Management*, 27(2), 147-162.
- KYOTO Protocol, 1997
- Paris Convention, 2015