Some Aspects of the Analysis of Citizens' Appeals to Municipalities on Environmental Issues

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Abstract

The results of the analysis of the citizens' appeals on environmental quality at the municipal level as a practical basis for organizing operative observations on the atmospheric air quality by using mobile environmental laboratories have been presented. It has been established that the analysis of citizens' appeals on the issues of unsatisfactory atmospheric air quality allows not only to determine the conditions for an operational response to the appeal, but also provides a basis for a more detailed analysis of the reasons that have provoked a significant number of appeals, namely: proximity to operating technic objects, motor transport highways, meteorological conditions that contributed to the formation of unsatisfactory atmospheric air pollution conditions, etc. At the tendency level, it has been determined that the combined appeals' analysis in the hourly intervals according to the seasons of the year along with the fixed main meteorological parameters values will allow to provide reliable forecasting of the sudden air quality deterioration conditions, locally, within the settlement boundaries.

Keywords: *citizens' appeal, environment, operational observations, quality, atmospheric air.*

1. Introduction

Today, in Ukraine, on the way to a democratic society, methods of electronic governance are increasingly being used, including the use of electronic communications to increase citizens' participation in the process of making managerial decisions at different levels. The prevalence of such democratization methods is not a new process, especially for developed countries. So, the Center for Technology in the Governmental State University at Albany of New York [1] provides with a comprehensive definition of the concepts related to the e-government activities. The author [2] provides an explanation concerning the interaction theoretical foundations and schemes in E-government systems to ensure the implementation of the E-democracy concept. He presents the latter as an instrument to enable citizens, through the use of information and communication technologies, to realize their rights and fulfill their obligations in the society of information and knowledge at a certain time and a certain place independently: a citizen is involved in explaining and planning public authority activity and their improvement. It also has been noted that the information and discussion policy should be adapted to the citizens' needs, it should provide unhindered access to the Internet for electronic polls, the creation of communities in various spheres of society, the realization of their rights at every communal level, and the improvement of political control with the help of adequate archiving and documentation systems. The authors [3] have thoroughly analyzed the emotional component influence while realizing citizens' rights to appeal. An argumentative conclusion has been made concerning emotional reactions in the process of expressing thoughts which is also really important at the "dry" pragmatic statements level. And this is the thing that accelerates the processes of making managerial decisions based on the citizens' electronic appeals results. It is known that one of the most important aspects of society's life, especially in technogenic regions, is the environmental situation analysis. In such circumstances, the public's influence on environmental decision-making is a part of the E-democracy system.

The authors of the article [4] have described some experience of citizens' influence on local environmental decisions. The paper [5] proposes an environmental governance concept, covering relations and interaction between government and non-state structures, procedures and conventions where power and responsibility are exercised in environmental decision-making. It has also

been stressed that the government actions study from the point of view of environmental policy and decision-making is an urgent task, but it is also necessary to observe the way citizens take responsibility and develop environmental initiatives. The paper [6 Public] analyzes the ASEM experience (Asia-Europe Meeting) in exploring the role of the community as an element of appropriate governance and as a means of citizens' mobilizing. Special attention is paid to public participation in solving environmental issues. Also, in developed democratic countries considerable attention is paid to the legislative aspects of the realization of citizens' rights to information about the environmental state. Consolidated information concerning the peculiarities of the environmental legislation norms implementation, the authorities' functions at different levels in solving environmental issues are widely spread among the population [7]. [8] provides explanations on the legal aspects of communicating with authorities for citizens. Particular attention is paid to the issue of activating the public's position in solving environmental issues as a way of consolidating their own rights. The processes of society democratization in Ukraine have not been left behind the issues of introducing E-government elements.

So, in [9] the author has analyzed the processes of correspondence processing in the regional state administration and the processes of improving work with citizens' appeals. The author draws attention to the mandatory e-government implementation and offers ways to improve the "citizens' appeal" electronic system as an e-governance element. The author [10] has displayed the mechanism of citizens' electronic appeals consideration from the experience of the Ukrainian Parliament Commissioner for Human Rights. However, in Ukraine, the issue of ensuring public access to substantiated environmental information, especially to the information on environmental monitoring systems, is rather a problem [11]. The system of ensuring the effective access of Ukrainian citizens to the results of environmental monitoring is practically absent. Meanwhile, providing citizens with electronic access to environmental information, including the results of observations the environment components state is one of the key positions in forming the concepts of the atmospheric air environmental monitoring systems' development and implementation at the municipal level [12].

It should also be noted that the work system organization of the citizens' appeals to municipal authorities concerning the issues of the environment component quality, appeals consideration and response to them perform an extra important function of raising the population environmental self-consciousness level.

Thus, the organization of the citizens' appeals registration system concerning environmental degradation is an important task for the municipal authorities, both in terms of stimulating controlling and supervising functions, and in terms of raising the city community environmental awareness level. The other important thing is the question of responding to citizens' appeals, as in the case of the observations organization the question is in extra financial costs, which require estimated forecasting as well as a certain rationing of their number.

2. Theoretical Part

In terms of the air quality observations organization in the technically load urban system territory that has already been formed historically, which means that the characteristics of the vast majority of air pollution stationary sources are known, as well as road transport traffic by major highways and streets, the factual basis for the operational observations organization is the local citizens' appeal to the municipal "hot" line with reports concerning sudden air quality deterioration or possible excessive air pollution. Thus, for organizing and conducting operational control of environmental components pollution including the air, the most appropriate way is the use of mobile environmental laboratories (MEL). In such conditions there is an interconnection in the "citizens' appeal on environmental issues - operational control organization" system.

Thus, the difficult task requires solution: on one hand, every citizen's appeal on municipal "hot" line on the air quality deteriorating issue is important and requires immediate response, on the other hand, the organization of such a process will be economically inefficient.

As an option for this compromise problem solving, we propose to determine the targeted minimum number of city residents' (citizens') appeals registered at the municipal hot line for a certain period of time. To establish the minimum number of appeals, mathematical statistic elements have been applied, taking into account the importance of environmental issues. In other words, it is necessary to determine the minimum amount of respondents, whose appeals to the "hot" line can be considered as non-random and reliable. It should be noted that the sample population amount installation is the problem which is not so much statistical, as it is meaningful. That is, the sample population amount depends on a significant number of factors, including goals and objectives, theoretical model, hypotheses and research methods, the general population homogeneity degree and, finally, on the accuracy of the information received, etc. In the case of citizens' appeals concerning the sudden atmospheric air quality deterioration, the general

population amount can be considered as apriority homogeneous, on the basis that in the questions of environment quality deterioration, each respondent seeks for its immediate improvement. In this case, the only purpose of sample forming is to assess the significance of the atmospheric air quality deterioration issue during the organization of operational observations. In sociology it is considered that if the sample amount is homogeneous, it is enough to conduct a survey among even a few citizens to obtain a reliable result. Thus, only a small number of appeals are enough to assert that these appeals are not accidental.

Therefore, in order to establish the minimum number of citizens' appeals for the urgent atmospheric air state observation organization the MEL departure it is expedient to investigate the existing registered appeals database. In the database analysis, it is necessary to determine the maximum appeals number for the air quality deterioration during 12 hours (e.g., at night time), then to determine the maximum appeals number in an hour interval (appeals / hour), to set the values obtained as the approximate minimum appeals number per time unit interval for expedited MEL departure. In the collecting statistics process, the minimum appeals number can be monitored and adjusted.

3. Results

Kremenchug (Poltava region, Ukraine) is a multidisciplinary industrial center of the Middle Dnipro. At the edge of the northern part of town, the compact group of powerful industrial enterprises including PJSC "Ukrtatnafta", PJSC "Kremenchug Plant of Technical Carbon", Kremenchug Heat Energy Central of PJSC "Poltavaoblenergo" is situated. These objects share accounts for almost 80% of harmful substances emissions into the atmosphere from the total amount in the town. To the southwest of this industrial group is the residential district of the town of Kremenchuk that is the settlement "Molodizhne" (see Figure 1). The inhabitants of this area suffer the most from the negative impact on the atmospheric air, which these objects create. In 2016, the system of electronic citizens' appeals registration on problematic issues, including issues on the environment deterioration, was started up in the town. One of the organizational decisions concerning the municipal authorities response to the citizens' appeal concerning sudden air quality deterioration is to carry out an operational control over the air pollutants content with the help of MEL. In order to determine the indicative appeals number from citizens of Kremenchuk, which is the reason for the MEL departure, we have analyzed the citizens' appeals database and identified almost 1600 residents'

complaints on the air quality deterioration in 2016. 10 cases of the maximum appeals number in the hourly interval from the set database have been analyzed and ranked. The results of the analysis are presented in table 1.

Table 1: The maximum number of citizens' appeals in the hourly interval

Maximum appeals number per hour	Date	Time interval	Town District
36	29.06.16	17:01 - 17:59	Centre, Molodizhne
32	29.06.16	19:01 - 19:57	Molodizhne
22	04.08.16	21:04 - 21:55	Molodizhne
19	15.07.16	23:00 - 23:57	Molodizhne
18	23.06.16	22:08 - 22:53	Molodizhne
17	30.06.16	20:01 - 20:59	Molodizhne
15	28.06.16	21:02 - 21:58	Molodizhne
14	16.07.16	22:04 - 22:59	Molodizhne
14	29.06.16	20:00 - 20:57	Molodizhne
13	15.07.16	22:02 - 22:58	Molodizhne

However, the results of the data analysis presented in table 1 do not allow a reasonable determination of the minimum appeals number, since ten cases of the maximum appeals number per hour shown in the table occur only in the summer period of the year, therefore, they do not reflect the situation for the year as a whole.

This way, the value of the maximum appeals number in the hourly interval by months of the year has been determined additionally. The results are presented in table 2.

Table 2: The maximum number of citizens' appeals per month during 2016

Maximum appeals number per hour	Date	Month of the year	Time interval	Town district
36	29.06	June	17:01 - 17:59	Molodizhne, Centre
22	04.08	August	21:04 - 21:55	Molodizhne
19	15.07	July	23:00 - 23:57	Molodizhne
9	13.09	September	21:08 - 21:40	Molodizhne
8	27.05	May	16:09 - 16:58	Molodizhne
8	26.10	October	08:00 - 08:54	Molodizhne
6	20.11	November	21:23 - 21:23	Molodizhne
4	08.01	January	08:05 - 08:47	Centre
4	20.04	April	18:28 - 18:47	Molodizhne
2	13.02	February	12:31 - 12:38	Molodizhne
2	29.03	March	17:55 - 17:57	Molodizhne
2	22.12	December	10:43 - 10:44	Molodizhne
The average of the maximum appeals amount per year is 10,17				

This reflection of the appeals database analysis results (monthly during the year) has allowed to determine the average value of the maximum appeals number per year in the monthly interval, and, as a result, set the minimum appeals number per hour for the operational environmental laboratory departure.

It should also be noted that the analysis of citizens' appeals on the poor air quality issues allows not only to determine the conditions for an operational response to the appeals, but also provides a basis for a more detailed analysis of the reasons that provoked a significant appeals number, namely: proximity to existing industrial objects, motor transport highways, meteorological conditions that contributed to the unsatisfactory atmospheric air pollution formation and the like.

Analysis of the appeals database has allowed determine the town district from which the largest appeals number was received. The data was systematized according to the addresses from which appeals were received for five gradations: 1-20, 21-50, 51-90, 91-150, 151-250 appeals. The results are plotted of the map within the Molodizhne town district location in Kremenchuk (Figure 1).

Legend: • 1 to 20 appeals; • 21 to 50 appeals; • 51 to 90 appeals; • 91 to 150 appeals; • 151 to 240 appeals.
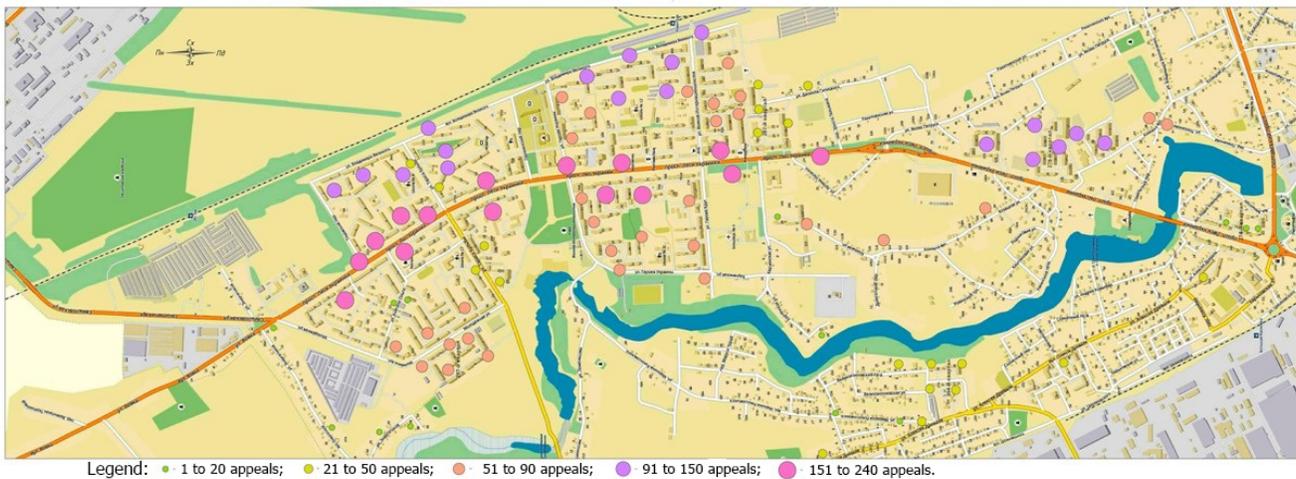
Fig. 1 Appeals distribution on the air quality deterioration in Molodizhne town district of Kremenchuk

Graphical visualization analysis of the appeals number distribution indicates that the maximum citizens' appeals number is observed from the areas of residential building, located directly in the Northern industrial complex enterprises active pollution zone of the city as well as and from the areas close to the main transport highway.

Such a situation suggests that in the zones mentioned the increased number of citizens' appeals is a consequence of the summing up effect of both industrial objects and transport in the terms of meteorological conditions contributing to pollution of the air. This assumption requires verification by means of direct pollution levels laboratory control in these zones compared with those outside the direct transport influence.

The data presented in tables 1 and 2 have been analyzed in comparison with the main meteorological factors: wind direction and wind speed. At the same time, it has been put forward the task of checking the hypothesis that the wind direction and its speed have an impact on the number of citizens' appeals. Confirming or refuting of such a hypothesis at least at the apparent trend level (since the sample size does not allow for reasoned conclusions to be drawn) will allow the development of a prediction tool for situations of sudden atmospheric air quality deterioration based on data from two databases: appeals and meteorological situations.

The results of the comparative analysis are presented in tables 3 and 4.

Table 3: Analysis of meteorological factors during the occurrence of ten cases of the maximum appeals number

Appeals number	Date	Time interval	Prevailing wind direction	Maximum wind speed, m / s	Average wind speed, m / s	Maximum temperature of atmospheric air, degrees	Average air temperature, deg.
36	29.06.	17:01 – 17:59	east	3,5	1,08	29,77	25,26
32	29.06.	19:01 – 19:57	North-west	4,1	1,29	25,68	24,76
22	04.08.	21:04 – 21:55	North	3,6	1,46	28,96	22,86
19	15.07.	23:00 – 23:57	east	2,9	0,52	33,88	28,02

18	23.06.	22:08 – 22:53	North	4,1	1,16	30,10	25,52
17	30.06.	20:01 – 20:59	North-west	3,8	1,72	21,18	21,00
15	28.06.	21:02 – 21:58	east	3,6	1,04	30,53	26,33
14	16.07.	22:04 – 22:59	North-east	3,3	1,30	36,44	29,57
14	29.06.	20:00 – 20:57	North-west	4,0	0,96	25,68	24,09
13	15.07.	22:02 – 22:58	North-east	4,0	0,94	35,81	29,25

Table 6: The analysis of meteorological factors at the time of the maximum appeals number per month during the year

Appeals number	Date	Month of the year	Time interval	Prevailing wind direction	Average wind speed, m / s	Average air temperature, deg.
36	29.06.16	June	17:01 – 17:59	east	1,08	25,26
22	04.08.16	August	21:04 – 21:55	North	1,46	22,86
19	15.07.16	July	23:00 – 23:57	east	0,52	28,02
9	13.09.16	September	21:08 – 21:40	North-west	1,71	22,47
8	27.05.16	May	16:09 – 16:58	North	1,22	21,09
8	26.10.16	October	08:00 – 08:54	South-east	3,59	0,37
6	20.11.16	November	21:23 – 21:23	-	0	0
4	08.01.16	January	08:05 – 08:47	west	2,53	0,5
4	20.04.16	April	18:28 – 18:47	-	0	9,21
2	13.02.16	February	12:31 – 12:38	North	3,26	3,04
2	29.03.16	March	17:55 – 17:57	west	1,1	12,79
2	22.12.16	December	10:43 – 10:44	-	0,25	-0,67

Taking into account the geographical features of the industrial enterprises group location concerning residential construction (Figure 1), it can be concluded that the following wind directions are significant in terms of the impact on residential development: North, North-East, and East. The worst conditions that contribute to the maximum values of ground concentrations formation in the pollution zones due to the reduction of the pollutants dispersion efficiency occur at values less than 2 m/c.

To test the hypotheses we have proposed, we use statistical analysis methods.

Taking into account the fact that it is necessary to investigate the qualitative variables effect – the wind direction or its strength on the quantitative – the appeals number, we consider the use of factor (dispersion analysis) as the most expedient way.

1) To determine the first factor influence, we break the combined data of tables 5-6 into six groups in the wind direction. To assess the factor influence significance, we put forward the hypothesis: $H_0 : S_1^2 = S_2^2$, where S_1^2 is the intergroup dispersion value; S_2^2 is the intragroup dispersion value.

To test the hypothesis we apply F- criterion, $F = \dfrac{S_1^2}{S_2^2}$. .

We find intergroup dispersion $S_1^2 = 121.554166$;

and intrapolar dispersion $S_2^2 = 79.616667$.

Then we have F = 1.526742726. The F-criterion value obtained is compared with the critical one found for degrees of freedom (level factor number minus 1) and $k_2 = 16 - 6 = 10$ (observation number minus group number). The significance level α assumes 0.05 as the most used level of significance, $\alpha = 1 - p$, where p is the confidence result probability. According to the Fisher-Snedecore critical values distribution tables we find the critical value F = 3.326. And, since $F_{розр} < F_{крит}$ there is no reason to reject the null hypothesis, the influence of the "wind direction" factor should be considered insignificant.

2) The influence of the "wind speed" factor has been investigated on the "appeals number" quantitative indicator The following factor levels have been adopted: "low wind speed": from 0 to 1 m / s; "average wind speed": from 1 to 20 m / s; and "high wind speed": from 2 m / s and above. Accordingly, the observations aggregated according to tables 5-6 have been divided into three groups by factor levels. To assess the impact, the hypothesis was put forward $H_0 : S_1^2 = S_2^2$. Similarly to the previous case, we find intergroup dispersion $S_1^2 = 229.8447368$; intragroup dispersion $S_2^2 = 77.13125$. The obtained value $F_{розр} = 2.979917$ is compared with the critical one that is found for degrees of freedom $k_1 = 3 - 1 = 2$ (group number by factor levels minus 1) and $k_2 = 19 - 3 = 16$ (observation number minus factor level number). The level of significance is considered as 0.05. According to the

distribution tables we find a critical value $F_{крит} = 3.633723$. And, we determine that at such a level of significance, the influence of the factor should be considered insignificant.

The obtained values, especially with regard to the "wind speed" factor influence, do not have logical explanations, which is most likely due to the insignificant data amount in the sample. We will try to raise the significance level, that is, to lower the confidence level in the result. Let's take value $\alpha = 0.1$. By the distribution tables we find a new critical criterion value: $= 2.668171$. Now $F_{розр} > F_{крит}$, therefore, the null hypothesis should be discarded, or, in other words, it can be assumed that in 90% of cases (at the confidence level $p = 1 - 0.1 = 0.9$) the appeals number depends on the wind speed level.

4. Conclusions

The organization of the citizens' appeals registration system dealing with environmental degradation is a vitally important task of the municipal authorities, both in terms of stimulating controlling and supervising functions, and in terms of raising the level of community environmental awareness. Certain aspect of the analysis of citizens' appeals is the establishment of operational control organization expediency - the urgent monitoring of the environmental components quality with the use of mobile environmental laboratories. For example, in Kremenchuk (Ukraine), we have analyzed the citizens' appeals database and identified about 1,600 residents' appeals on the air quality deterioration in 2016. The minimum number of appeals per hour for the operational environmental laboratory arrival has been determined.

It has also been established that citizens' appeals analysis on the issues of unsatisfactory atmospheric air quality allows not only to determine the conditions for an operational response to the appeal but also provides a basis for a more detailed analysis of the reasons which have provoked a significant number of appeals, namely: proximity to existing industrial objects, motor transport highways, meteorological conditions that contributed to the formation of unsatisfactory atmospheric air pollution and the like.

The samples of database applications have been analyzed in comparison with major meteorological factors: wind direction and wind speed. At the same time, it has been put forward the task of checking the hypothesis that the wind direction and its speed have an impact on the number of citizens' appeals. The results obtained provide a basis for the formulation suggested that joint statistical analysis of a citizens' appeals database on the sudden air deterioration with a local weather stations database in the context of the

considered parameters: speed, wind direction, which is interesting in terms of the high potential for predicting quantitative applications "burst" depending on a combination of meteorological factor indicators with constant industrial facilities negative impact.

Thus, conducting joint application analysis in hourly intervals according to the seasons along with the recorded local weather station meanings of basic meteorological parameters like average wind speed, wind direction, average and maximum temperature will use the regression analysis power for problems of sudden air quality deterioration forecasting locally within the settlement boundaries..

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