

# Analysing the Cases of Population Disease at Critical Levels of Environmental Pollution by Emissions, Discharges, and Waste

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## Abstract

As a result, we investigated population disease at critical levels of pollution emissions, discharges, and the waste environment worldwide. We did a detailed analysis of the dataset and demonstrated obtained results. We also studied the composition and structure of the interrelationship of quantity population disease at critical pollution emissions, discharges, and waste in the environment in European countries. We concluded that in Romania, most numbers formed households and enterprises waste causes more diseases in the population.

## Keywords 1

Analysis, Dataset, RStudio, Treemap, Pie Chart, Histogram, Population Disease, Critical levels, Environmental Pollution, Emissions, Discharges, Waste, Power BI Desktop, Language Programming R, Circular Economy, Ukraine

## 1. Introduction

The problem of developing methods for determining the amount of socio-economic damage caused to the social system (population) is directly related to the development of methods for economic assessment of the amount of compensation (reimbursement) [1-3] for those social damages caused by the economic activity of enterprises.

Pollution surrounding the natural environment negatively is indicated on health. Contaminated atmospheric air may become the source of body breathing penetration into the body's harmful substances [3-5]. Contaminated water may contain pathogenic microorganisms that are also dangerous for health substances [6-8]. Contaminated soil and soil water worsen the quality of agricultural products and food.

A man has long since considered the environment natural environment basically as a source of raw materials stocks (resources) needed for pleasure and their own needs [9-10]. This big part taken from natural resources returns to nature as waste. The main part of this waste and pollution is formed in cities.

In cities, railways and roads continuously transported cargo and people [11-13]. All these species transport strongly pollute the atmosphere by exhaust gases that contain harmful substances for a person's health.

In everyone modern smart city, as a result of life activities, people are formed much industrial and household waste [14-17]. An unpleasant smell often spreads far from landfills near the bridge, on landfills multiplying a large number of flies, mice and rats, which are carriers of different pathogenic bacteria. Activity, a person, leads to permanent pollution surrounding natural medium: atmospheric air, natural waters and soils [18-22].

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## 2. Analytical review of literary and other sources

### 2.1. Analytical review of reference

The existence of quantitative data on emissions, discharges and waste, the number of diseases of the population, and their dynamics do not make it possible to assess the essence of the destructive impact of production on the environment and the population. We detailed and analysed the following specific indicators in our previous works [1, 2, 7, 10, 25].

- Resource intensity is the specific consumption of natural resources per unit of finished products
- Energy intensity is the specific consumption of electricity per unit of produced products
- Land intensity is the specific use of land resources for production
- Waste intensity is the specific generation of waste per unit of production
- Loss intensity is the specific losses of society associated with changes in natural and human capital.

The authors describe these indicators' exact calculation methods in works [1, 2, 7, 10, 25]. Pollution is an introduction into the environment or occurrence in new ones, usually non-characteristic physical factors, chemical and biological substances which harm natural ecosystems and a person [18-22].

By spatial distribution (size covering territory), pollution shares the following [18-22]:

- Local pollution is characteristic of cities, significant industrial enterprises, districts mining or other useful minerals, and significant livestock complexes.
- Regional pollution that is covers significant territories and water areas that subject to impact significant industrial districts
- Global pollution, more often called atmospheric emissions, spreads at a big distance from places his emergence and creates an unfavourable influence on large regions and, sometimes, on the whole of the planet.

Article 6 of the Law of Ukraine "About protection of atmospheric air" [28] is provided for evaluations stating atmospheric pollution air are installed regulations ecological security atmospheric air and regulations marginally permissible emissions into the atmosphere air polluting substances, levels harmful impact physical and biological factors within populated points, in recreational ones zones, in others places residence, permanent or temporary stay people, objects surrounding natural environment with a purpose software ecological security citizens and the environment natural environment [28]:

- Regulations on the quality of atmospheric air
- Marginally acceptable levels impact acoustic, electromagnetic, ionising, and other physical factors and biological impacts on state atmospheric air populated points.

For resort, medical and recreational, recreational and other individual districts they can to be installed more strict regulations on ecological security atmospheric air

By force and character actions on the environment pollution there are [22-28]:

- Background
- Impactful
- Permanent
- Catastrophic.

By sources occurrence pollution share on [22-28]:

- Industrial (for example, SO<sub>2</sub>)
- Transport (for example, aldehydes exhaust vehicles)
- Agricultural (for example, pesticides)
- Household (for example, synthetic laundry means).

By type origin [22-29]:

- Physical pollution is a change in thermal, electrical, radiation, light fields in the natural environment, noises, vibrations, and gravitational forces caused by a person
- Mechanical pollution is different solid particles and items (thrown out as unusable, activated, or withdrawn from use).
- Chemical pollution is solid, gaseous and liquid substances, chemical elements and compounds of artificial origin which enter the biosphere, disturbing installed by nature's processes of circulating substances and energy.

- Biological pollution is different organisms that appear thanks to life activities, humanity, bacteriological weapons, new viruses like pathogens AIDS, diseases, legionnaires, epidemics, and other diseases, as well as catastrophic reproduction plants or animals, relocated from one environment into another person or accidentally.

## **2.2. Study of the factors that cause the disease**

The WHO notes that two of the biggest ecological killers in the world are strokes and heart attacks (2.5 million per year) [30]. Further are going diseases hearts (2.3 million) [31-33] and cancer (1.7 million) [2, 7, 8], respiratory diseases (1.4 million) [2, 34] and diarrhoea (846 thousand) [2, 7, 35]. The WHO report defined a whole number of ecological reasons and their communication with mortality, namely [36-39]: pollution surrounding the environment, the influence of chemical substances, change climate and ultraviolet radiation, and others.

Pollution air can charge 8.2 million cases of death, including influenced secondary tobacco smoke, which responds to cardiovascular diseases, cancer and chronic respiratory disease [2, 7]. In the opinion of general WHO director Margaret Chen [40], if the conditions surrounding the environment will not become the best, then mortality will only grow. Since a clean environment lays the foundation for the health of the planet's entire population, states must do everything to create an environment so safe for life and work that millions of people do not get sick and die too young.

The number of deaths from diseases specified in the WHO report is also striking in Ukraine [41]. On the official page of the All-Ukrainian census population, there is a statistic of basic reasons for mortality among Ukrainians [42, 43]. Therefore, Ukrainians often died from disease systems blood circulation (more than 440 thousand persons for eight years) and neoplasms (more than 92 thousand). By these years, number population had decreased by 3.7% [44-46]. However, whether relevant these data are today, to say it's hard for a new census has long not been held, and for the last years situation could very to change no better [47-49].

There is a forecasted amount of economic compensation for the consequences of man-made pollution in the industry [1, 2, 7, 8, 50], which is the amount of financial compensation for treating each type of disease caused by changes in the natural environment.

More thorough studies of the impact of discharges of polluted water on the number of cases of disease among the population in the Ukraine industry region were carried out in work [51], in which the dependence between the number of discharges and the number of diseases of the respiratory organs, circulatory systems. Also, in the already mentioned work [51], the share of the man-made component of indirect damages was calculated - the costs in Ukraine for treating cases of disease caused by the man-made load on the environment (pollution of water). It is, on average, about 20% of the total costs of treating patients. In the works [1, 2, 7, 8, 52, 53], the authors, investigating the relationship between the factors of man-made influence and their consequences for the population within the defined pollution zones, built the correlation-regression model of diseases caused by territory pollution. The model includes quantitative indicators and qualitative characteristics such as proximity to the sea and the level of territory afforestation. The indicators should also include the number of newly registered cases of diseases in Ukraine, the number of deaths from certain diseases, the number of registered cases of disability from occupational diseases, and the number of work-related injuries and accidents.

## **2.3. Analysis of existing negative factors**

Most of the health of Ukrainians affects by polluted air. Annually in Ukraine, the atmosphere stands out about 17 million tons of harmful substances. Moreover, some of these substances have considerable influence on climate change and, therefore, on deteriorating state health. Enterprises of black metallurgy, energy, coal, chemical and petrochemical industries contribute to the pollution of air, in particular. We also have large emissions from thermal power plants and cars, which grow yearly. The morally and physically outdated systems for cleaning the atmosphere emissions of metallurgical enterprises cause growing air pollution. Also, illegal deforestation in the Carpathians causes serious natural disasters, as the author proves [54-58].

The majority of sources today pollute different genus enterprises and themselves residents countries. Moreover, in polyhydric Ukraine, there are still problems with drinking water. After all, most sources today pollute different genus enterprises and their resident countries. Therefore, stocks of water resources in one Ukrainian make 1.8 cubic meters per year, which is not the lowest indicator in Europe.

However, doctors say the biggest danger is the Chornobyl disaster, with consequences that still have not been fully eliminated. The explosion in Chornobyl still is a danger to society. People all apply to us with problems that arise after disasters. Most suffered in this period were more a child; after all, diseases appear already at more mature ages [55-56]. Many people, after the explosion, remained live in the zone of radiation, and for these years state, their health worsened. Some people still live in disadvantaged areas and undergo radiation. Except that, you can take away Donbas, Luhansk or even Poltava to dangerous regions countries from this points zone. In general, the duration of life after independence decreased by a few years. Most people impresses cancer and diseases hearts [57].

Experts [58] claim that over the years state things only worsen. Ukraine - on to the second place in Europe by pace spread of cancer, every year from this one disease die about 90 thousand persons, of which 35 % - people able-bodied age. By the last ten years, the number of patients has grown by 25%, while the general population decreased by several million [59]. The only example of this work is shown in Table 1.

Table 1. Sources emissions the environment [60]

<b>Branch industry</b>	<b>View emissions</b>	<b>Harmfulness</b>
Coal, metalworking, paper	Emissions, which contain particles of sand, rocks and other mechanical impurities	They can violate natural ecosystems and sanitary regimes to silt up the bottom and shore
Machine building factories, enterprises, chemical industry	Throw that out are formed because of neutralisation and cleaning sewage water	The environment gets polluted with salts, difficult metals, cyanides, acids, toxic organic and inorganic compounds
Ore beneficiation, coal beneficiation, leather factories	Pollution, which contains micro- and macronutrients	Pollution in the environment excessive quantity of micro- and macroelements, in separate cases pathogens diseases ( leather factories )
Alcohol, sugar, starch and molasses and other factories	Pollution, which contains organic compounds of vegetable and animal origin	Pollution in the environment organic compounds which light can rot cause infectious disease

Deaths related to external pollution [60]: 40% are cardiovascular disease, 40% are strokes; 11% are chronic obstructive disease lungs (COPD); 6% are cancer lungs; 3% are acute infections lower respiratory ways in children.

Deaths related to pollution by air within premises [60]: 34% are strokes; 26% are cardiovascular disease; 22% are COPD; 12% are acute infections of lower respiratory ways in children; 6% are cancer lungs.

The indicators should also include the number of newly registered disease cases in the population of Ukraine, the number of deaths from certain diseases, the number of registered cases of disability from occupational diseases, the number of injuries and accidents at work.

### 3. Experiment

#### 3.1. Structure dataset

We combined the datasets “The number of diseases of the urban population” [61] and “Air quality and its pollution in the cities of the world”. The first dataset contains information on the general disease level of the urban population. The second dataset describes the air quality and pollution caused by heavy environmental pollution in the world’s cities [62]. It is important that in the obtained dataset (Fig. 1), we have the following composition of data: name of the city, region, country, air quality, water pollution, and population disease level [61-62].

City	"Region"	"Country"	"AirQuality"	"WaterPollution"	"Disease"
New York City	New York	United States of America	46.81603773584906	49.504950495049506	0,6667194
Washington	D.C.	United States of America	66.12903225806451	66.12903225806451	0,097629993
San Francisco	California	United States of America	60.51401869158879	43	0,891971408
Berlin		Germany	62.3641304347826	28.61271676300578	0,869008851
Los Angeles	California	United States of America	36.62162162162163	61.29943502824858	0,958959367
Bern	Canton of Bern	Switzerland	94.31818181818181	12.5	0,680571534
Geneva	Canton of Geneva	Switzerland	71.53846153846153	17.3728813559322	0,411108277
Zurich	Canton of Zurich	Switzerland	83.80952380952381	10.714285714285715	0,925457968
Basel		Switzerland	81.66666666666667	26.923076923076923	0,30282578
London	England	United Kingdom	37.04225352112676	40.716374269005854	0,895111883
Cairo	Cairo Governorate	Egypt	15.830721003134796	74.35064935064935	0,793520939
Alexandria	Alexandria Governorat	Egypt	41.0377358490566	71.2962962962963	0,212803657
Alexandria	Virginia	United States of America	89.0625	46.15384615384615	0,474466347
Paris	Ile-de-France	France	34.02439024390244	43.12169312169312	0,712855446
Boston	Massachusetts	United States of America	78.23529411764706	32.91139240506329	0,995773571
Toronto	Ontario	Canada	65.53468208092485	37.79940119760479	0,220777404
Sao Paulo	Sao Paulo	Brazil	24.056603773584907	73.71794871794873	0,796794392
Vilnius		Lithuania	77.24719101123596	20.588235294117645	0,374790478
Monaco		Monaco	28.787878787878785	61.36363636363637	0,270536178
Brussels		Belgium	35.810810810810814	44.761904761904766	0,981756838
Poznan	Greater Poland Voivodeship	Poland	33.07692307692307	50.42372881355932	0,056830395
Tashkent		Uzbekistan	56.4516129032258	49.166666666666664	0,814182556
Warsaw	Masovian Voivodeship	Poland	27.27272727272727	36.01485148514851	0,528363155
Modena	Emilia-Romagna	Italy	39.0625	50	0,578778583
Tours		France	84.375	6.25	0,450337902
Singapore		Singapore	65.87837837837837	24.204946996466433	0,450323244
Montreal	Quebec	Canada	70.76023391812866	36.963190184049076	0,195760059
Cambridge	England	United Kingdom	69.82758620689656	30.555555555555557	0,14450157
Cologne	North Rhine-Westphali	Germany	60.71428571428571	27.777777777777778	0,042361308
Skopje	Greater Skopje	North Macedonia	10.194174757281555	45.26315789473684	0,948282108
Gdynia	Pomeranian Voivodeship	Poland	49.41860465116279	48.611111111111111	0,871681194
Szczecin	West Pomeranian Voivodeship	Poland	41.37931034482759	53.75	0,802489728
Ljubljana	Ljubljana City Municipality	Slovenia	72.16494845360825	17.58241758241758	0,24869297
Plovdiv	Plovdiv region	Bulgaria	31.41025641025641	36.29032258064516	0,894455049
Sofia	Sofia City Province	Bulgaria	23.621323529411764	40.943396226415096	0,579352361
Milan	Lombardy	Italy	24.397590361445783	39.490445859872615	0,507642596

Figure 1 The combined dataset of diseases of the urban population and air quality and pollution in the cities of the world

#### 3.2. Analysis dataset

We used the R.Studio [63] program and language programming R [64]. Analysis dataset was conducted with the help such diagrams such as Treemap [65], Pie Chart [66], and Histogram [67], which are depicted below. Based on the analysis diagrams, we conducted our analysis and determined the main points.

1. Treemap [68-69] reflects hierarchical data in the form set of nested rectangles. Each group presented a rectangle, a square whose proportional magnitude. Using coloured schemes, we introduced sprat dimensions: groups and subgroups. The chart of Fig. 2 depicts countries on the quantity content specified by the dataset. Analysing the present treemap, we can watch significant morbidity in countries such as Germany, Italy, Canada and the USA.

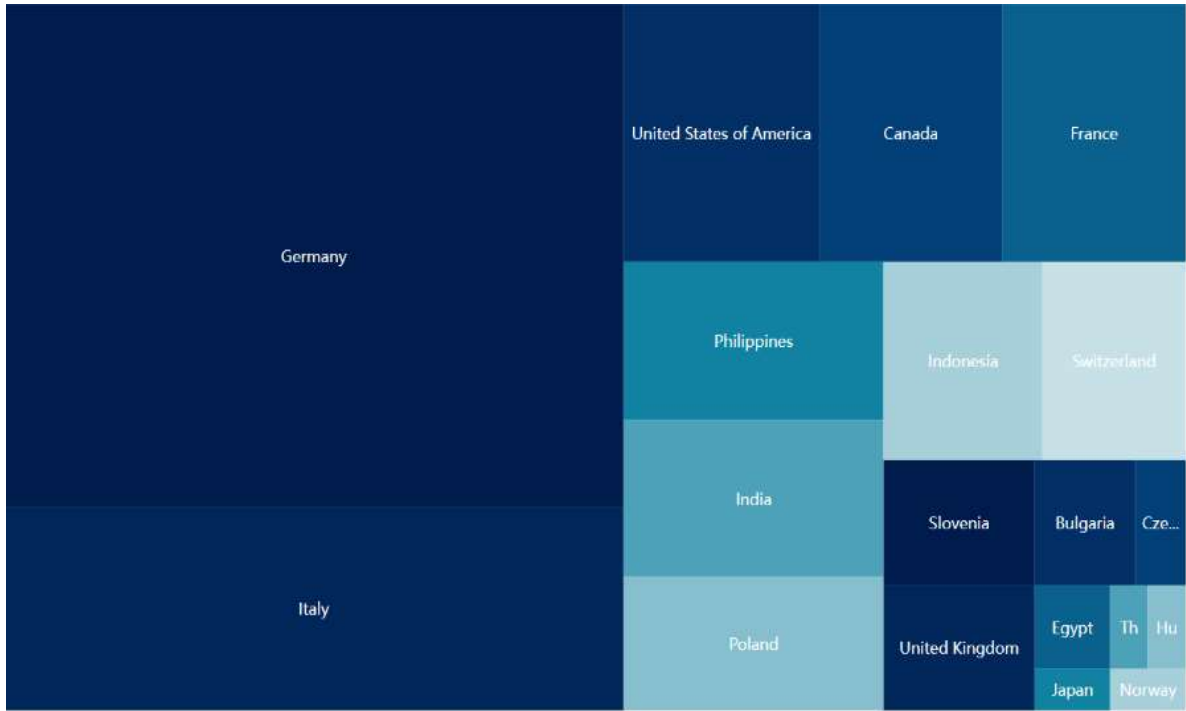


Figure 2. Chart Treemap

2. PIE CHART [66] is a circle divided into sectors, each of which shares the whole. It often uses for display proportions, where the sum sectors are equal to 100%. In the diagram (Fig. 3), we can watch the air quality in each country's condition for 2020. Having done analysis, we conclude that the highest quality air is in Switzerland and the smallest quality air is in France.

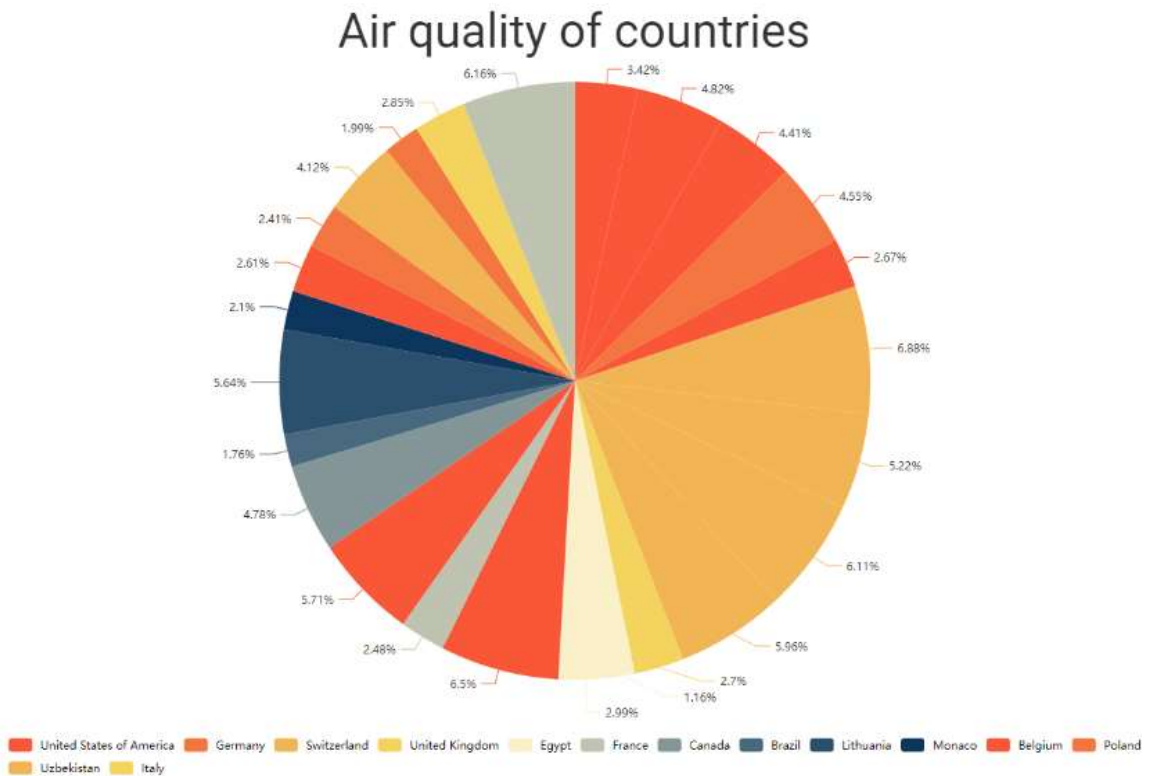
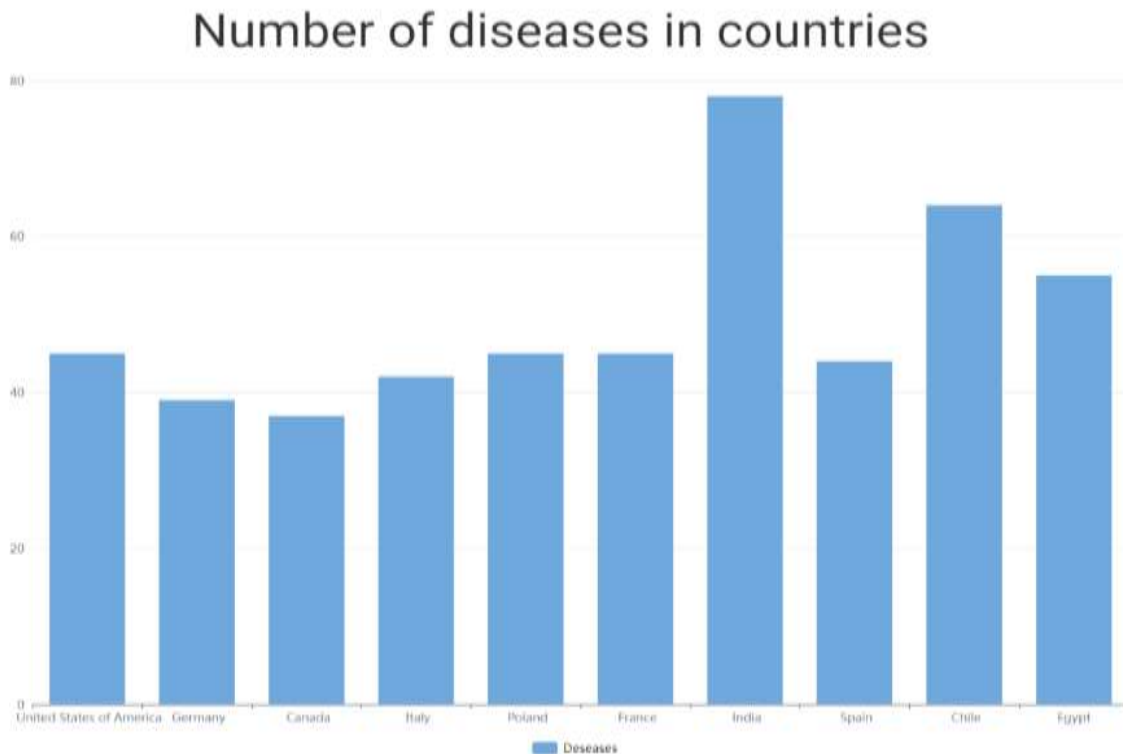


Figure 3. Pie Chart of air quality of countries

3. Histogram [67] is a method of graphic representation of tabular data, approximately representing numerical data (Fig. 4). A histogram appears as a diagram that consists of rectangles without gaps between them. Quantitative correlation is some indicator presented in rectangles with proportional areas. Most often, width rectangles are taken the same for amenities of perception. At this, their height determines the correlation displayed parameter.



**Figure 4.** Histogram chart of the number of diseases in countries

The Histogram chart (Fig. 4) depicts the number of diseases in different countries in 2020. Analysing the current schedule, we can watch the biggest number of diseases in India, Chile and Egypt and the smallest Indicators we observe in Canada, Germany and Italy.

#### 4. Results of work in the R environment

First, to work with the tmap package in the Rstudio environment, we established connections with external servers using R programming language commands. Next, we installed the tmap package using the following command: [68-76]:

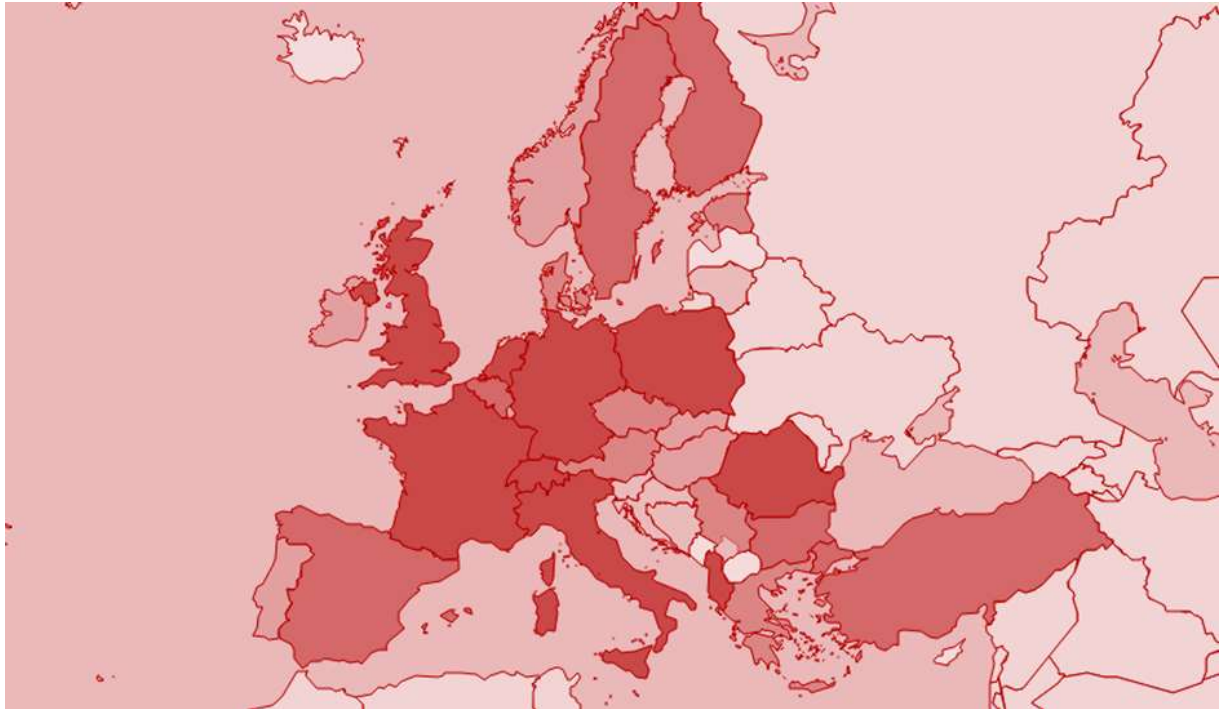
```
install.packages ("tmap ")
```

Package tmap designed for the creation of thematic maps with considerable flexibility. The syntax for the creation of graphs is similar to the ggplot2 syntax. Still, with adding maps, this package offers a flexible approach to basis layers and an easy-to-use approach for creating thematic maps, such as choropleths and bubbly maps. There is based on grammatical graphics.

We displayed the map of Europe (Fig. 6) with the help of the following commands.

```
library( tmap )
data("Europe")
tm shape ( Europe)+
+   tm polygons ("HPI")
```





**Figure 6.** Map of Europe removed by help package tmap

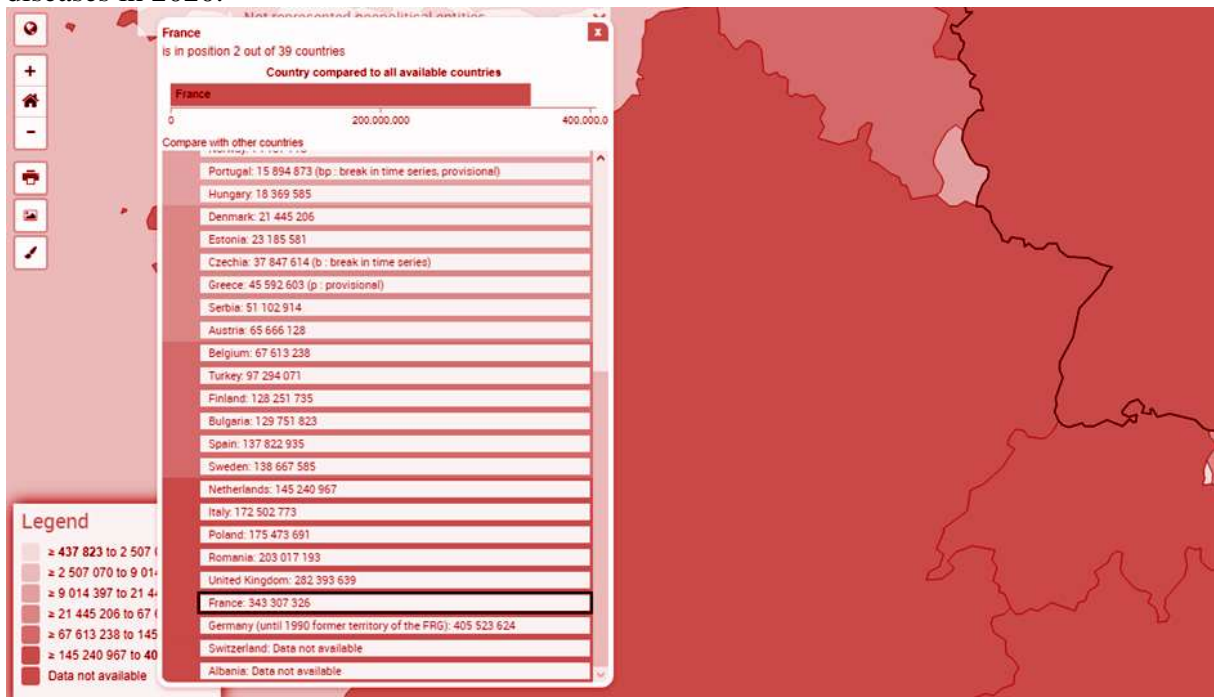
We used the following commands to view the world maps in interactive mode.

tmap mode (“view”)

tm shape ( Europe) +

+ tm polygons (“HPI”)

We also used the ability to change the map’s scale, namely the ability to bring the map of Europe closer to the size of a specific country (Fig. 7). Figure 7 shows a map of France and the number of diseases in 2020.



**Figure 7.** Interactive card



## 5. Discussion

Taking into account the results obtained in our previous works [1, 2, 7, 8], we concluded that the factors of public perception of the destructive impact of pollution are described by indicators that determine the levels (quantitative and qualitative) of receptivity of the recipients of actions of destructive impacts depending on the state of the subsystem (economy, society, nature), among which are: levels of infrastructure, transport, communication, disease, mortality, birth rate, etc., as well as the quality and structure of the main characteristics of the subsystems: the number of different categories of the population, its structure, the quality of agricultural land, the sensitivity threshold of the ecosystem, the stability of the economy, etc.

The source of population diseases in cities is industrial production, transport and the provision of certain types of services related to the collection and storage of waste, the supply of electricity, gas, steam and air conditioning, etc. [77-96]. The system of indicators for assessing population diseases does not directly concern the source of their formation but rather their consequences. The consequences of human economic activity are the loss of non-renewable natural resources, the significant deterioration of the state of renewable resources, the accumulation of hazardous waste and, as a result, the deterioration of the quality of labour resources, even their loss.

The problem of effective use of productive assets, rational resource provision and obtaining profits from the economic activity of enterprises is directly related to the problem of economic evaluation of those losses, damages and losses (in kind and value forms) that enterprises experience in the process and as a result of their activities.

Morally outdated production technologies lead to high levels of pollution of the natural environment, accidental damage or destruction of the main production assets, and a decrease in indicators of the viability of labour resources, which leads to an increase in man-made losses in the national economy.

In the case of the economic assessment of man-made losses in the national economy (from the point of view of the assessment of losses as consequences of economic activity), it is advisable to use a balanced system of indicators, which would make it possible to carry out a full and objective assessment of precisely these consequences, i.e. not only the volumes of man-made impact but also the results its effects on the environment and society (indirect man-made damage, damage to future generations). Therefore, we added new indicators following the theoretical and practical needs of assessment, modelling and forecasting of the relevant macro indicators.

In addition to man-made load indicators (specific volumes of emissions, discharges, generation of waste of all hazard classes), volumes of environmental payments (environmental tax, fines), costs of environmental protection activities (capital investments, costs of major repairs and current costs), the system included as well as indicators that characterise the social, natural, and economic living conditions of the population of Ukraine, namely: the level of the natural radiation background, climatic features (forestry, proximity to the sea, etc.), the mortality rate of children under the age of 1, the average monthly nominal salary of employees, the ratio population mortality rate, population birth rate, average age of the population, etc., as well as indicators of the quality of health, social protection and injuries at work (number of cases of newly registered diseases, number of cases of first-time assigned disability for persons of working age, number of deaths due to malignant diseases neoplasms, the number of pensioners due to disability, the average amount of the monthly disability pension, incapacity for work as a result of injuries at work, the number of victims of injuries, the amount of payments to victims and families of the deceased, fines paid for cases caused by the fault of entrepreneurs, etc.).

## 6. Conclusions

As a result, we investigated population disease at critical levels of pollution emissions, discharges, and the waste environment worldwide. We did a detailed analysis of the dataset and demonstrated obtained results. We also studied the composition and structure of the interrelationship of quantity population disease at critical pollution emissions, discharges, and waste in the environment in European countries. We concluded that in Romania, most numbers formed households and enterprises waste causes more diseases in the population.

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