

## ENVIRONMENTAL TAXES IMPACT FOR THE POPULATION HEALTH PROTECTION: CROSS-COUNTRY ANALYSIS

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**Abstract:** *The current demographic situation in the world encourages the search and implementation of optimal tools for stabilizing the population's life expectancy and ensuring their health. The study was designed to investigate the impact of environmental taxes, as environmental policy instruments, on the state and the health of the population. The analysis of scientific works, built based on the Publish or Perish software, made it possible to confirm the unfailing relevance of research on the topic of the impact of environmental taxes. Where environmental taxes are considered as a tool for influencing the level of pollution of the surrounding natural Environment and indicators of life and health of the population. The analysis of scientific works published in recent years under the keywords «environmental tax» and «healthy» based on the Scopus scientometric database also confirmed the study's relevance, considering the level of citations of the presented works. Some authors pay considerable attention to additional taxation of producers of harmful products and subsidizing enterprises that grow or produce eco-products. Other scientists emphasize changing the existing environmental legislation (increasing environmental tax rates, targeted use, introducing additional critical emission limits, etc.). They believe this will have the effect of a hidden intervention in the prevention of disease through reducing climate change. The main part of the study was based on visual confirmation of the relationship between environmental taxes and the population's level of health using the VOSviewer software product. This bibliometric analysis confirmed that limiting the environmental pollution level due to environmental taxes determines the possibility of improving the population's health. At the same time, financial instruments for curbing habits harmful to human health also have a positive impact. Clustering made it possible to: confirm the impact of environmental taxes on the actual level of environmental pollution; reflect the dependence of personal habits and tendencies that affect the life and health of the population; to argue the fact that ecological culture and the culture of a healthy lifestyle are formed not only by objective but also by subjective reasons, as well as by the general psychological state of the population; to confirm the existence of the socio-regulatory orientation of the ecological tax, including the environmental exposure and the level of health of the people, etc. The graphical method (built based on Stata software) made it possible to confirm that environmental taxation can improve the state of the natural environment. The transmission nature of environmental taxation's impact on the population's life and health is also determined. The research results are a scientific basis for developing the latest environmental policy, which would fully enable the environmental tax to perform its compensatory function, as well as ensure the formation of green production and expand the access of individuals to quality food products.*

**Keywords:** environmental tax, environmental taxation, life expectancy, demography, ecology, natural Environment, morbidity.

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**Introduction.** Life expectancy and public health is closely related to the world environmental situation. According to the World Health Organization (Environment and health, 2022), about 18% of deaths in 53 countries were caused by environmental stress, while 25% of diseases arise as a result of environmental determinants of health (WHO, 2013). Some specialists believe that the high mortality rate is due to environmental changes driven by atmospheric air pollution and dangerous chemical substances (European Environment Agency, 2021). At the same time, others consider that the problem also lies in limited access to clean water and fertile soils (ISGlobal, 2020). On the other hand, some scientists do not single out environmental issues that could significantly influence life expectancy, focusing only on financial and social factors (Bohk and Rau, 2015).

The systematization of scientific treatises showed no unique scientific view regarding the direct or indirect influence of environmental factors and environmental tax payments on life expectancy and public morbidity levels. Therefore, this study suggests conducting a bibliographic analysis of scientific works on the specified subject and distinguishing interdependent factors.

Literature review. In order to confirm the research topic's relevance, this study applied the Publish or Perish software allowed to summarize the statistics of the publications by domestic and foreign scientists. The sample of scientific papers was generated using the combinations of keywords: environmental tax AND health, environmental health, ecological life expectancy. The research period covers 49 years.

Table 1 presents the findings of the statistical analysis. The statistical analysis showed the high value of indices, confirming the representativeness and importance of the investigated topic regarding the population's environmental taxation, health, and life expectancy.

At the same time, it is essential to mention that the scientific works devoted to ecological tax with health and environmental health are the most considerable. The above is confirmed by the total number of works, the level of citations, and the indicators of h- and g-indexes.

**Table 1. Static analysis of Environmental tax and health, environmental health and ecological life expectancy over 1973-2022 as of 11/06/2022 (among most cited 1000 studies)**

№	Metrics	Environmental tax AND health	Environmental health	Ecological life expectancy
		Keyword	Keyword	Keyword
1	Papers	990	980	999
2	Citation	242570	419945	134912
3	Cites per year	4950,41	8398,90	1984,00
4	Cites per paper	245,02	428,52	135,05
5	Author paper	2,48	3,31	2,69
6	h-index	236	382	180
7	g-index	483	575	350

Sources: developed by the authors.

Therefore, the findings confirmed the continued relevance of the study of environmental taxes impact. Noteworthy here, in this case, the environmental taxes are considered to be a tool for influencing environmental pollution and indicators of life quality and public health.

This study operates with scientific papers indexed in the scientometric database Scopus by the keywords «environmental tax» and «healthy». In order to select the relevant publications, a search filter was applied for the 2019-2021 years. Besides, the results were filtered by the subject fields: «Environmental Science», «Social Sciences», «Business, Management and Accounting», «Earth and Planetary Sciences», «Business, Management and Accounting», «Energy» and «Medicine». Table 2 presents the study sample.

**Table 2. The sample of foreign scientific papers by the search request «environmental tax» and «healthy»**

№	Author (year)	Bibliometrics	Quotation
1.	Akseer, N., Kandru, G., Keats, E. C., & Bhutta, Z. A. (2020).	COVID-19 pandemic and mitigation strategies: Implications for maternal and child health and nutrition. American Journal of Clinical Nutrition, 112(2), 251-256. doi:10.1093/ajcn/nqaa171	97
2.	Broeks, M. J., Biesbroek, S., Over, E. A. B., Van Gils, P. F., Toxopeus, I., Beukers, M. H., & Temme, E. H. M. (2020)	A social cost-benefit analysis of meat taxation and a fruit and vegetables subsidy for a healthy and sustainable food consumption in the netherlands. BMC Public Health, 20(1) doi:10.1186/s12889-020-08590-z	7

**Continued Table 2**

<b>Nº</b>	<b>Author (year)</b>	<b>Bibliometrics</b>	<b>Quotation</b>
3.	Graça, P., Gregório, M. J., & Freitas, M. D. G. (2021).	A decade of food and nutrition policy in Portugal (2010-2020). <i>Portuguese Journal of Public Health</i> , 38(2), 94-118. doi:10.1159/000510566	5
4.	Latka, C., Kuiper, M., Frank, S., Heckelei, T., Havlík, P., Witzke, H. -, . . . van Dijk, M. (2021)	Paying the price for environmentally sustainable and healthy EU diets. <i>Global Food Security</i> , 28 doi:10.1016/j.gfs.2020.100437	7
5.	Wilson, N., Cleghorn, C. L., Cobiac, L. J., Mizdrak, A., & Nghiem, N. (2019)	Achieving healthy and sustainable diets: A review of the results of recent mathematical optimization studies. <i>Advances in Nutrition</i> , 10, S389-S403. doi:10.1093/advances/nmz037	23

Sources: developed by the authors.

Over the past three years, many articles considered the relationship between environmental taxes and public life and health. Table 1 lists the most cited publications. Therefore, Akseer et al. (2020) determined that the consequences of COVID-19 were bigger than the health deterioration of the major global population. These scholars believed that food systems, income and social protection, health services for women and children, and services and access to clean water and sanitation would be at particular risk of collapse due to the pandemic. Under those mentioned above, the governments of all countries should be ready to ensure a moderate environmental position. It is the key to global public health, combined with social protection, which would help ensure a healthy home environment and reduce the pandemic's negative consequences.

Wilson et al. (2019) focused on assessing the relationship between environmental problems and the food system. The mathematical methods, the authors proved that healthy eating reduces the impact on the Environment. The findings showed that the preferences in plant products contribute to environmental sustainability. At the same time, the consumption of meat (especially pork and lamb), confectionery, and alcoholic beverages directly reduce the population's life expectancy and increase morbidity. Therefore, the authors emphasized the necessity of meaningful policy changes, providing the introduction of a tax on unhealthy food. In turn, it would positively affect sustainable production and the dynamics of eco-product consumption. Moreover, it would proportionally influence the ecological sustainability of regions and the planet.

Latka et al. (2021) emphasized introducing additional taxes on unhealthy food and subsidies for organic production. Thus, the scholars determined that the current level of environmental pollution and the level of morbidity requires the introduction of additional taxation and subsidization of food producers. Implementing the proposed package of such policies would ensure the achievement of nutrition and environmental sustainability goals.

Broeks et al. (2020) were the same opinion. The Dutch scientists determined the necessity to introduce food taxes and subsidies to promote healthy eating in society. The findings showed that introducing a meat tax (15% and 30%) and a subsidy on fruit and vegetables (10%) have net benefits for both public health and the Environment. Thus, the additional tax burden would lead to lower health care costs, higher quality of life and productivity. Regarding the Environment, additional taxation would increase environmental revenues by 3400 million euros (at a 15% tax rate) and 6300 million euros (at a 30% tax rate). In turn, subsidizing fruit and vegetable producers would increase their consumption, positively affecting public health. However, it may require 100 million euros of environmental costs.

It stands to mention some older scientific works presented in the Scopus scientometric database. Thus, Aronson et al. (2016) addressed environmental and biophysical degradation. The authors emphasized the necessity to introduce environmentally-friendly technologies, appropriate environmental taxes and fees, and increase the number and quality of investment projects for environmental restoration of soils, water bodies, and atmospheric air. Besides, the authors underlined a direct connection between ecosystem and human health. In contrast, ecosystem dysfunction increases the level of disease among people (due to the violation of the integrity of terrestrial, freshwater, and marine ecosystems), directly affecting life expectancy.

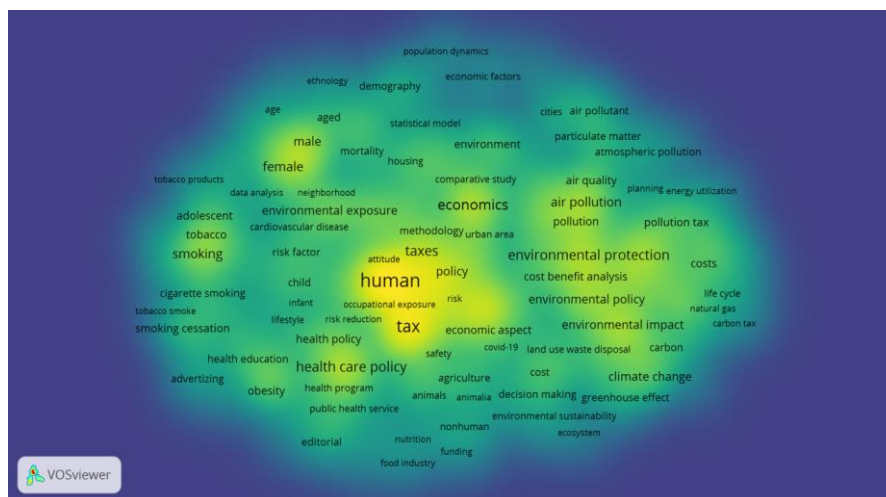
Lindström et al. (2010) drew a parallel between the number of diabetes patients and their quality of life. The obtained results showed that individuals who prioritize proper nutrition, physical activity, and maintain a healthy body weight are less prone to diabetes. Scientists also emphasized that nowadays, diabetes growth is observed not only among the elderly but also among the youth. The above resulted from the disdainful attitude of individuals toward a healthy lifestyle and the influence of environmental factors (for example, living near manufacturing enterprises, employment at chemical or industrial plants, giving preference to cheaper food products compared to the price policy of eco-products, etc.). Given this, the authors emphasized the need for

developing a comprehensive diabetes prevention program, the effectiveness of which partly depends on the functioning of the established mechanism for performing the compensatory function of the environmental tax.

Swinburn (2008) based the study on the influence of various factors on obesity, where special attention was paid to developing and implementing regulations designed to stimulate environmental and social changes. The author believes that the definition of a clear framework (in terms of marketing, standardized content of harmful substances, and additional labeling) for enterprises in the food industry, agriculture, and trade would enable active support of obesity prevention. In turn, changes in the existing environmental legislation (in terms of increasing tax rates, targeted use, introducing additional critical emission limits, etc.) would have the effect of a hidden intervention in preventing obesity due to mitigating climate change. This section is a concise summary of the main findings of the study. Revealed new phenomena and confirmed facts should be described and accompanied by an appropriate comment. The conclusions should be logically consistent with the title and purpose of the article, thorough, contain a comparison of the results with the analogs, recommendations for their implementation. It is advisable to give a clear vision of the prospects for further research in this area.

**Methodology and research methods.** Studies of modern tools for ensuring a healthy lifestyle and the population's health indicate the multi-component nature of interrelationships. In particular, one of the most important vectors of guaranteeing a healthy public life is maintaining the territorial environmental level, which is also achieved by the action of regulatory instruments, such as environmental taxes.

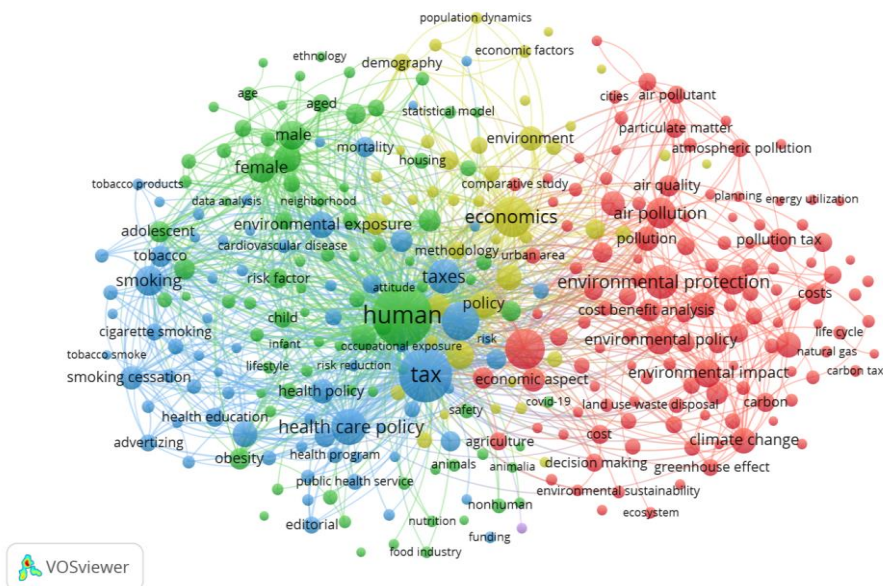
The bibliometric analysis results demonstrate the link peculiarities between environmental taxes and public health. Noteworthy here, the scientometric database Scopus contains 1097 articles that simultaneously use such keywords as «environmental tax» and «health». The issues of this research in a common context were studied in the period starting from 1959. An in-depth analysis confirmed the co-occurrence of 325 keywords that occur at least 10 times in the articles included in this sample. Figure 1 visualizes that the highest occurrence frequency had the keywords: «human», «tax», «health care policy», «economics», «environmental protection», «air pollution», «smoking», etc. The above pointed to the relationship between environmental taxes and public health has different transmission pathways. On the one hand, limiting the level of environmental pollution due to the effect of environmental taxes determines the possibilities of improving public health. On the other hand, financial instruments positively control the habits harmful to human health.



**Figure 1. Results of bibliometric analysis of the frequency of keywords co-occurrence on the request «environmental tax» and «health»**

Sources: developed by the authors.

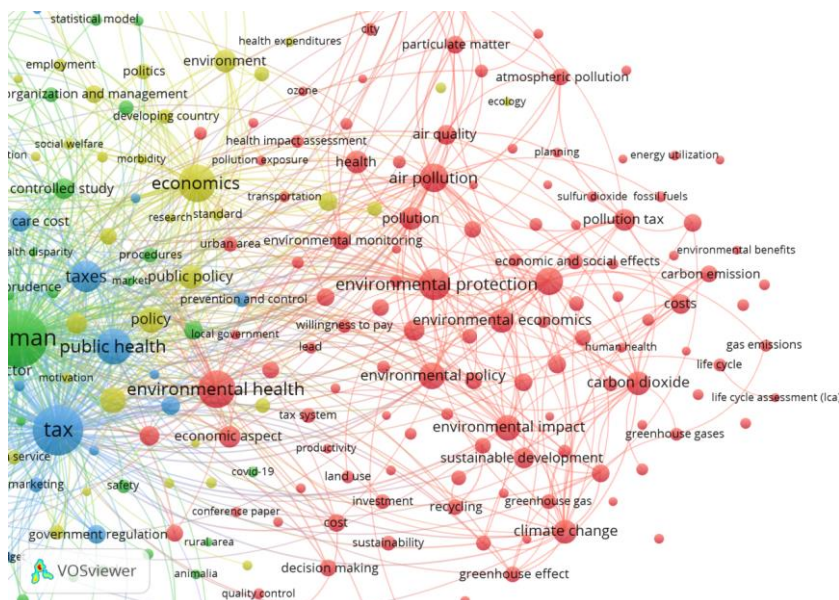
Accordingly, the next research stage identified the keyword clusters that mediate the channels of transmission links between environmental taxation and the healthy public lifestyle. Figure 2 demonstrates five clusters of keyword occurrences.



**Figure 2. Results of bibliometric analysis of keywords co-occurrence on the request «environmental tax» and «health»**

Sources: developed by the authors using VOSviewer 1.6.1 software.

Thus, Figure 3 presents the largest red cluster in more detail. This cluster consists of 125 keywords, while the most frequently are «environmental health», «air pollution», «climate change», «air quality», «environmental policy», «carbon dioxide», «pollution tax», «environmental impact», «sustainable development», «greenhouse gases», «recycling», «land use», «environmental monitoring», «costs», «economic and social effects», «life cycle» etc. This cluster demonstrates macroeconomic and nationwide manifestations of the environmental tax impact on the actual level of environmental pollution. Besides, it summarizes the main objects of taxation, as well as the goals of environmental tax policy.

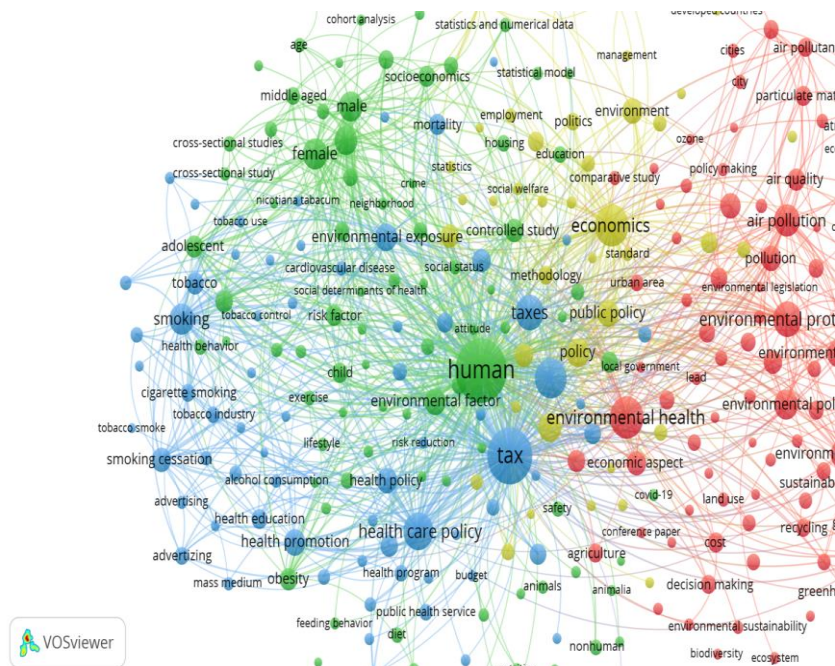


**Figure 3. Results of bibliometric analysis of keywords co-occurrences on the request «environmental tax» and «health» (red cluster)**

Sources: developed by the authors using VOSviewer 1.6.1 software.

The second-largest cluster (blue) consists of 86 keywords. In this cluster, the most frequently used are as follows: «tax», «smoking», «health care policy», «tobacco», «health promotion», «alcohol consumption», «health education», «advertising», «public health service», «environmental exposure», etc. (Fig. 4). This

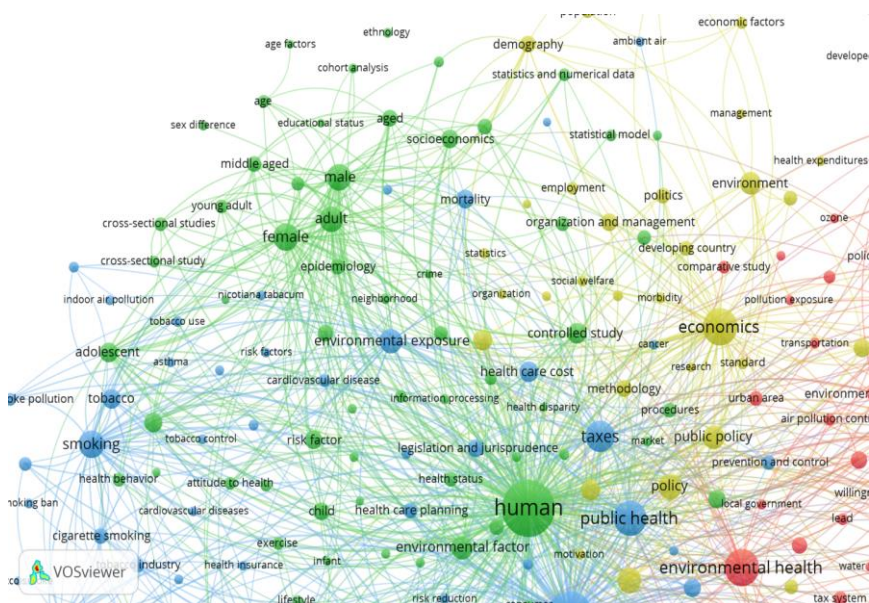
cluster reflects personal habits and tendencies that affect the public life and health, as well as public tools for the promotion of a healthy lifestyle and financial incentives for the transformation of the public consciousness to a healthier and more ecological one.



**Figure 4. Results of bibliometric analysis of keywords co-occurrences on the request «environmental tax» and «health» (blue cluster)**

Sources: developed by the authors using VOSviewer 1.6.1 software.

The next cluster is green (Fig. 5). This cluster includes 43 keywords. The most significant keywords in this cluster are «human», «adult», «female», «male», «socioeconomics», «epidemiology», «risk factor», «health status», «environmental factor», «health behavior», «attitude to health». The abovementioned keywords reflect the behavioral and gender aspects of transitioning to a healthy public lifestyle. It indicates the ecological culture and healthy lifestyle are formed not only by objective but also by subjective reasons, as well as by the general public psychological state.

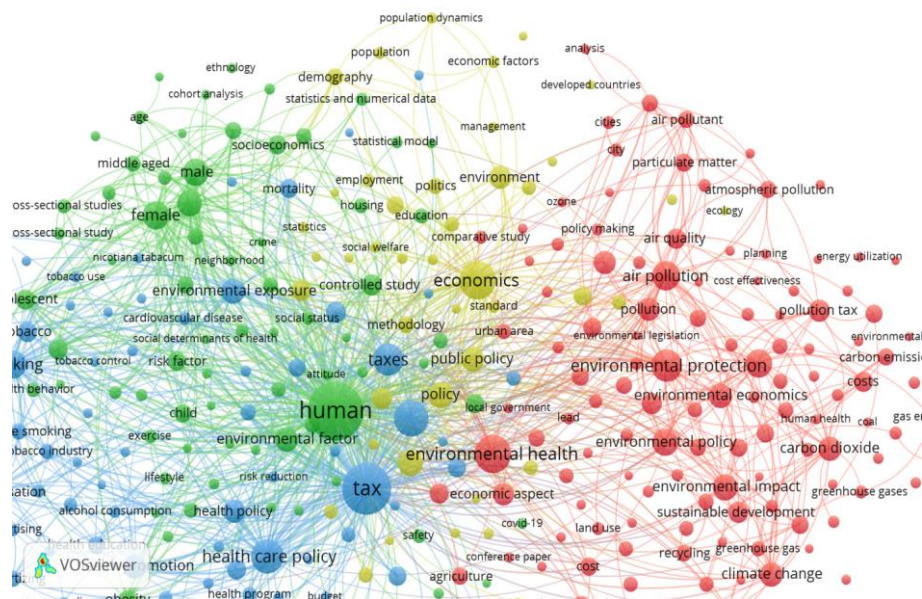


**Figure 5. Results of bibliometric analysis of keywords co-occurrences on the request «environmental tax» and «health» (green cluster)**

Sources: developed by the authors using VOSviewer 1.6.1 software.

The yellow cluster includes 43 keywords, while the most frequently used are «economics», «public policy», «demography», «environment», «population», «economic factors», «employment», «social welfare», «environmental degradation», «financial management», «health economics», «commercial phenomena», «government». Figure 6 presents the connections between these keywords, which indicate its social-regulatory focus. Thus, the study of the complex aspects of state regulation of social welfare, including the ecological direction and the level of public health.

In turn, the obtained results identified one more (purple) cluster, consisting of only one keyword – «lowest income group». It indicates that economic well-being is always considered a guarantee of effective regulatory influences on any processes taking place in society. For example, the insufficient population life quality reduces the relevance of ecologically responsible behavior and observance of a healthy lifestyle of the population.



**Figure 6. Results of bibliometric analysis of keywords co-occurrences on the request «environmental tax» and «health» (yellow cluster)**

Sources: developed by the authors using VOSviewer 1.6.1 software.

The analysis testified to various contextual links between environmental taxation and the population's life and health. At the same time, it turned out that these relationships are mostly mediated by several macro-financial parameters and indicators of the Environment. Therefore, studying environmental taxation impact as a tool for regulating public health should be carried out exclusively by analyzing transmission relationships.

The bibliometric analysis findings showed that the broadest channel is the environmental state, measured by its pollution level. That is why we will analyze the dependencies observed between the level of environmental taxation and the level of emissions of harmful substances into the surrounding Environment.

This analysis involved the following indicators:

1) income from environmental taxes, thousands of dollars. USA (enviro\_m\_taxes) – an indicator showing the intensity of the environmental taxation system functioning in the country;

2) indicators of the intensity of environmental pollution:

- nitrous oxide emissions, thousand metric tons of CO2 equivalent (no);
- CO2 emissions, metric tons per capita (co2);
- total greenhouse gas emissions, kt of CO2 equivalent (ghg);
- methane emissions, kt of CO2 equivalent (methane);

3) indicators of the population's life and health:

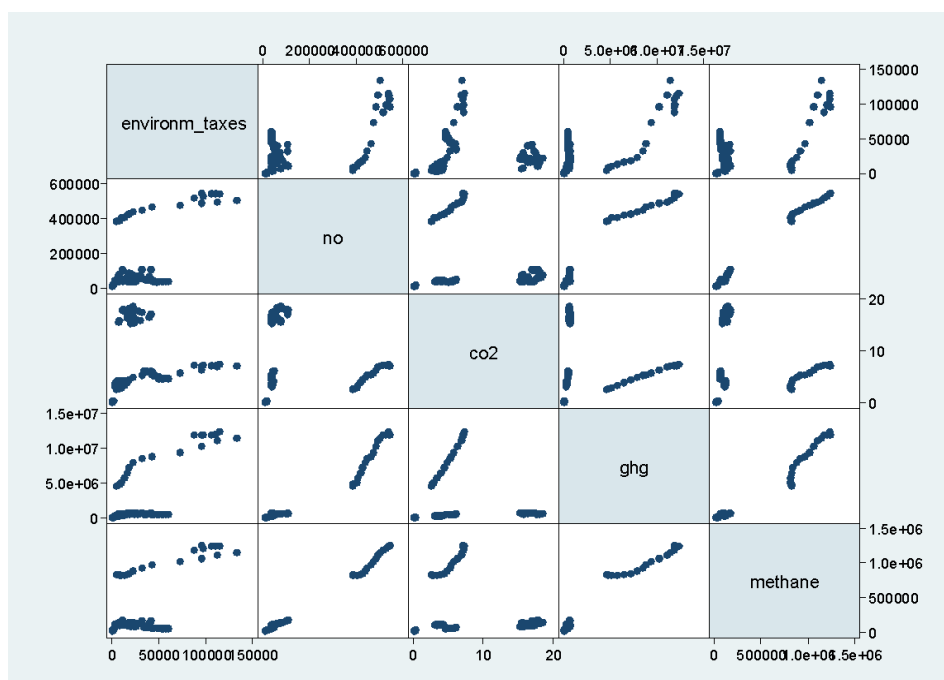
- life expectancy at birth, years (life\_exp);
- incidence of malaria, per 1,000 population at risk (malaria);
- incidence of tuberculosis, per 100,000 people (tuberculosis);

- mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70, % (mortcvdcancerdiabetes);
- mortality rate attributed to unintentional poisoning, per 100,000 population (mort\_poisoning).

Statistical data for the analysis covers 2000-2019 for six countries (China, Kenya, Australia, Argentina, Canada, and France). Thus, this study considered the peculiarities of the environmental taxation system functioning, approaches to leading a healthy lifestyle, the general level of well-being of the population, various initial natural conditions, industrial development, etc.

This study applied the graphic method of a scatterplot matrix to display several statistical indicators simultaneously. Thus, Figure 7 visualizes the data on environmental taxation and the level of emissions into the natural Environment. In turn, the given statistical data show the presence of certain dependencies between environmental tax revenues and environmental pollution. In most cases, the nitrous oxide emissions level was low, generating insignificant amounts of environmental tax revenues. On the contrary, the environmental tax revenues vary from a low level (in low-tax jurisdictions) to the highest in tax systems where the environmental taxation level is significant.

Thus, the prevailing situation is when environmental taxes perform more of a fiscal than a restrictive function. The situation regarding taxation of carbon dioxide emissions is somewhat different. Thus, at a relatively moderate level of emissions, the revenue from environmental taxes is directly proportional, while environmental taxes remain insignificant at the maximum pollution level by these gases. That indicates the imperfection of tax systems. Besides, in most cases, environmental taxes can restrain greenhouse gas and methane emissions. The growth of revenues from environmental taxes is significantly higher than the growth of these types of pollution. Thus, it indicates that environmental taxation could improve the natural Environment.



**Figure 7. Scatterplot matrix of environmental tax revenues and gas emissions**

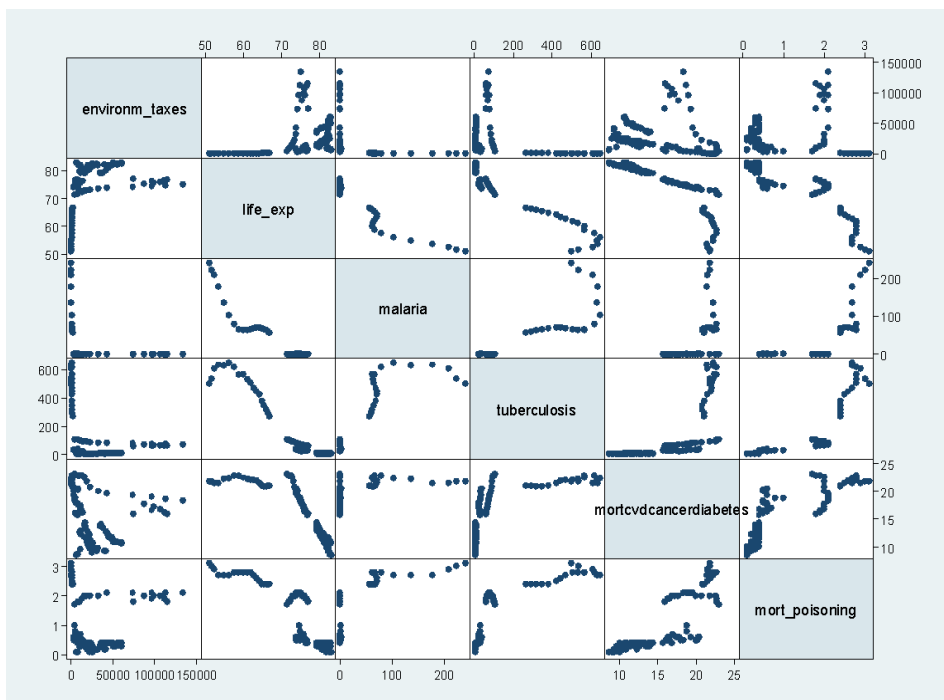
Sources: developed by the authors based on World Bank data.

In the next stage, this study investigated the influence of environmental taxes on the population's life and health (Fig. 8). Based on the given data, a directly proportional dependence between environmental taxation and the population's life expectancy could be clearly traced. The above indicates the potential for long-term effects of environmental promotion on public health.

On the other hand, it is interesting that according to the indicators of the incidence of malaria and tuberculosis in the population, the dependencies are quite ambiguous. Thus, in particular, a low level of morbidity corresponds to a wide range of intensity of environmental taxation. In contrast, data on higher levels of morbidity correspond to low values of revenues from environmental taxation. It is related to the significant variability of the sample countries. Besides, it characterizes the fact that the general low development of the



economic and tax system has a mutually determining environmental impact and does not allow managing the effects of ecology on the population's health.



**Figure 8. Scatterplot matrix of environmental tax revenues and health and life indicators**  
Sources: developed by the authors based on World Bank data.

Similar dependencies have also been recorded between environmental taxation and population mortality from various diseases and pollution. At the same time, the inverse dependence is more moderate. Thus, the higher the environmental taxation level is, the lower the mortality rate is. The above confirms the conclusions about the transmission nature of the environmental taxation impact on the population's life and health.

**Conclusions.** The study findings confirmed a strong relationship between the healthy life of the population and the ecological consciousness of the region in which they live. Environmental taxes are one of the tools used to achieve moderate anthropogenic impact on the Environment. The study sample was formed based on the Scopus scientific database using the VOSviewer software. Considering the sample of articles, the map of keyword occurrences consists of five clusters indicating the relationship between environmental taxes and public health has different transmission links. Besides, limiting environmental pollution due to environmental taxes determines the possibilities of improving public health, while financial instruments for controlling habits harmful to human health also have a positive impact.

The obtained results of bibliometric analysis testified to the presence of a fairly wide range of contextual links between environmental taxation and the population's life and health. Based on that, the dependence between environmental taxation and emissions of harmful substances into the Environment was analyzed. The findings of the graphic method confirmed that environmental taxation could improve the natural Environment and also determined the transmission nature of the environmental taxation impact on the population's life and health.

This study could be a basis for developing the updated environmental policy, which would fully enable the environmental tax to perform its compensatory function, as well as ensure the formation of green production and expand individuals' access to quality food products.

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**Conflicts of Interest:** Authors declare no conflict of interest.

**Data Availability Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

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### **Вплив екологічних податків на охорону здоров'я населення: міжкраїновий аналіз**

Сучасна демографічна ситуація у світі спонукає до пошуку та впровадження оптимальних інструментів стабілізації тривалості життя населення та забезпечення їх здоров'я. Дослідження було покликано дослідити вплив екологічних податків, як інструментів екологічної політики, на стан та здоров'я населення. Аналіз наукових праць, побудований на основі програмного забезпечення Publish or Perish дав змогу підтвердити незгасаючу актуальність дослідження тематики впливу екологічних податків. Де екологічні податки розглядають як інструмент впливу на рівень забруднення навколишнього природного середовища та показники життя та здоров'я населення. Аналіз наукових праць, опублікованих за останні роки за ключовими словами «environmental tax» та «health» на основі наукометричної бази Scopus також підтвердив актуальність дослідження враховуючи рівень цитування представлених праць. Деякі автори, досить значну увагу приділяють додатковому оподаткуванню виробників шкідливої продукції та субсидіювання підприємств які вирощують чи виробляють еко-продукти. Інші науковці наголошують на зміні існуючого екологічного законодавства (у розрізі збільшення ставок екологічного податку, цільового використання, впровадження додаткових критичних меж викидів, тощо). Вони вважають, що це буде мати ефект прихованого втручання на профілактику захворюваності через зменшення кліматичних змін. Основна частина дослідження базувалася на наочному підтвердженні взаємозв'язків між екологічними податками та рівнем здоров'я населення використовуючи програмний продукт VOSviewer. Такий бібліометричний аналіз підтвердив, що обмеження рівня забруднення довкілля внаслідок дії екологічних податків визначає можливості покращення стану здоров'я населення, тоді як позитивний вплив мають також фінансові інструменти стримування шкідливих для здоров'я людини звичок. Кластеризація дала

змогу: підтвердити вплив екологічних податків на фактичний рівень забруднення навколишнього середовища; відобразити залежність особистих звичок та схильностей, які впливають на життя та здоров'я населення; аргументувати той факт, що екологічна культура та культура здорового способу життя формуються не лише об'єктивними, а й суб'єктивними причинами, а також загальним психологічним станом населення; підтвердити існування соціально-регуляторної спрямованості екологічного податку включаючи екологічний напрямок та рівень здоров'я населення, тощо. Графічний метод (побудований на основі програмного забезпечення Stata) дав змогу підтвердити, що екологічне оподаткування здатне покращити стан навколишнього природного середовища. Також визначено про функціонування трансмісійного характер впливу екологічного оподаткування на життя і здоров'я населення. Отримані результати дослідження є науковим базисом для розробки новітньої екологічної політики, яка б у повній мірі дала можливість екологічному податку виконувати свою компенсаційну функцію, а також забезпечувала формування зеленого виробництва та розширювала доступ індивідів до якісних продуктів харчування.

**Ключові слова:** екологічний податок, екологічне оподаткування, тривалість життя, демографія, екологія, навколишнє природне середовище, захворюваність.