

Artificial Neural Networks (ANN) Approach for the Assessment of Air Quality: Bibliometrics Analysis

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Abstract

This study focuses on conducting a bibliometric analysis of research related to air quality assessment and artificial neural networks (ANN) over the past decade, using data obtained from the dimensions.ai database and analyzed through VOSviewer software. The research involved extracting data from the database and conducting analyses based on country-wise publications and citations, organization-wise publications and citations, and journal-wise publications and citations. The top 20 results were then subjected to detailed analysis. The findings revealed a noticeable increase in research activities within the specified field over time.

Keywords: Air quality, assessment, Bibliometrics, VOS viewer, Database.

1. Introduction

Mahendra et al. (2023) highlighted the growing concern over air quality and its direct impact on human lives, emphasizing the escalating threat posed by air pollution in emerging nations due to urbanization and industrialization (Mishra & Gupta, 2024). Environmental toxicology primarily focuses on understanding the movement and effects of toxic substances within biological systems, ecosystems, and food chains, with a particular emphasis on human health (Asha et al., 2022).

Over recent decades, rapid industrial and technological advancements have led to unsustainable use of resources, resulting in a surge in environmental toxins that disproportionately affect vulnerable populations such as children, pregnant women, and the elderly (Ke et al., 2022). Urban air quality has long been recognized as a critical issue, with implications for public health and economic productivity due to the prevalence of respiratory and circulatory ailments caused by exposure to polluted air (Liu et al., 2022; Nigam et al., 2013).

The accelerated urbanization and population growth have exacerbated environmental challenges such as deforestation, toxic waste disposal, and air pollution (Goyal & Kumar, 2011). Timely monitoring and forecasting of air pollution have become imperative to mitigate its impact on human health and the environment, especially in densely populated urban areas (Mishra & Goyal, 2016; Sekar et al., 2016).

Considering the importance of the research topic, the present research work is devoted to the Bibliometrics analysis for the key words *assessment of air quality using artificial neural network*, in order to investigate the scenario of research in the field. The research paper portrays the details of Bibliometrics analysis followed by discussion, and conclusion of the research.

2. Bibliometrics Analysis

The present Bibliometrics analysis was conducted on the open source database www.dimensions.ai, which provides free and downloadable Bibliometrics resources for helping the researchers belonging to different streams. For this purpose, the search terms used Assessment of air quality using artificial neural network, as a result of which the results numbers of research papers published in last ten were obtained, presented as follows.

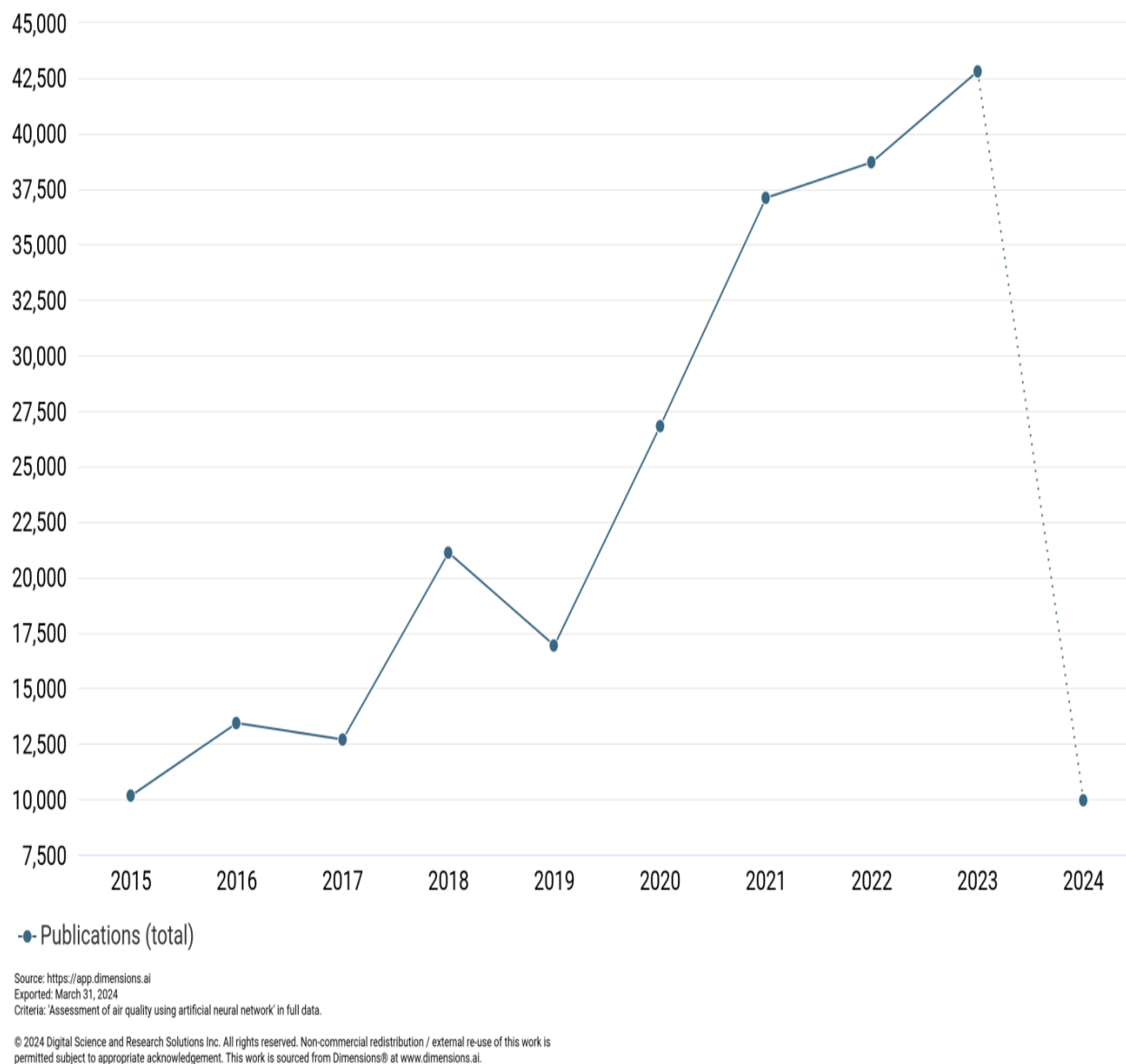
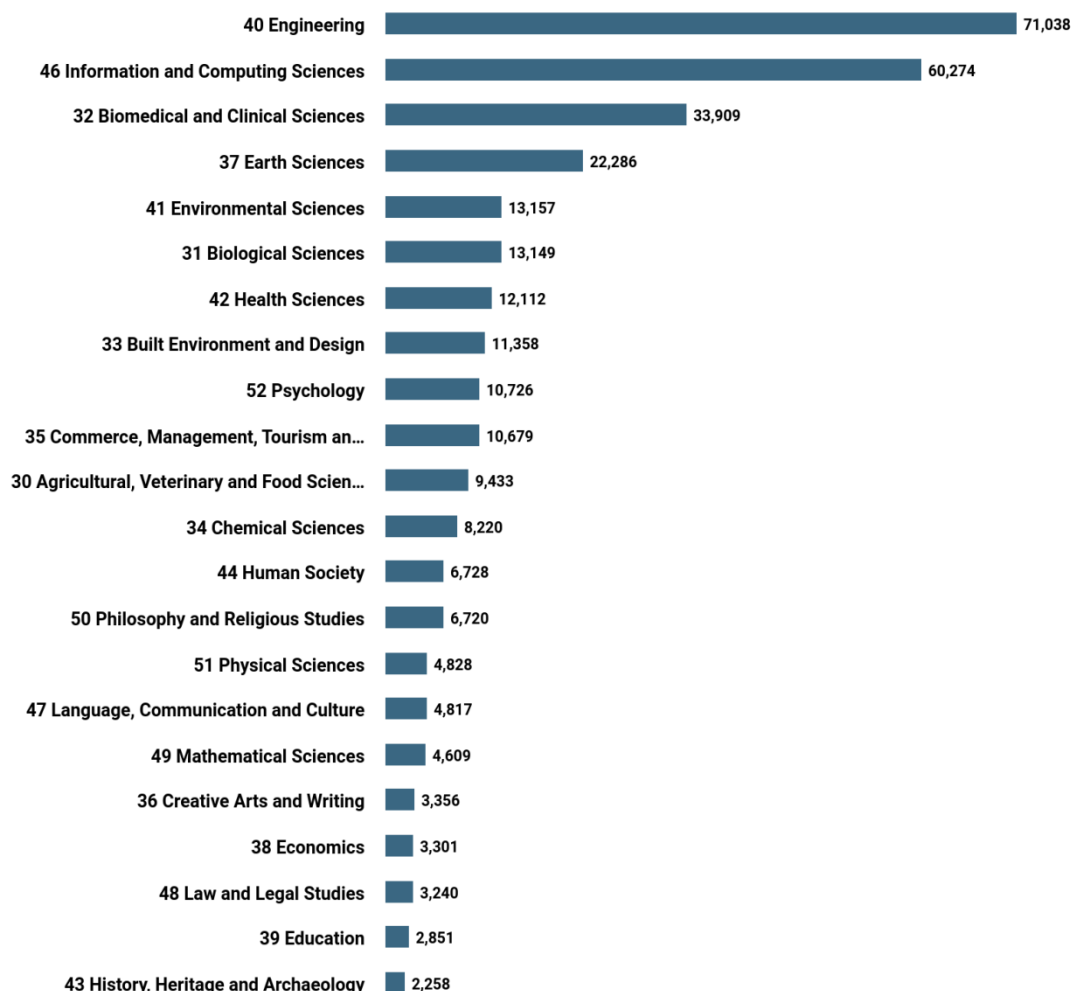


Figure 2.1: Numbers of Research Publications for Different Years (www.dimensions.ai)

The results obtained also displayed numbers of journals belonging to different fields as well as research articles belonging to those journals. Figure 2.2 presents details of number of journals, their streams as well as number of publications, belonging to those journals.



Source: <https://app.dimensions.ai>

Exported: March 31, 2024

Criteria: 'Assessment of air quality using artificial neural network' in full data.

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Figure 2.2: Number of Research Publications from Different Streams and Number of Journals (www.dimensions.ai)

The present bibliometric analysis was based on country wise publication and citation analysis, organization wise publication and citation analysis, and journal wise publication and citation analysis, the details of which are portrayed in upcoming sub-sections.

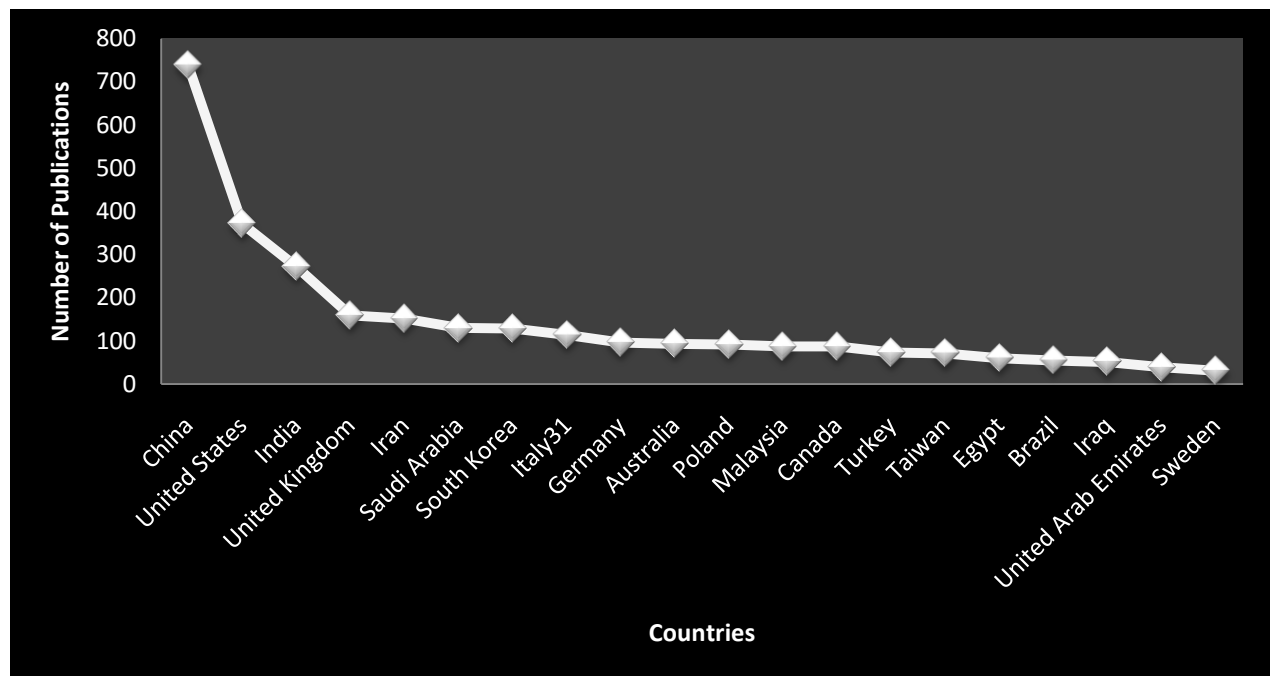
2.1 Country wise Publication and Citation Analysis

In the next stage, on analyzing the extracted dimensions.ai data in VOSviewer, number of publications as well as citations appeared in last ten years for different countries were obtained, the details of which are presented Table 2.1 for top twenty alternatives.

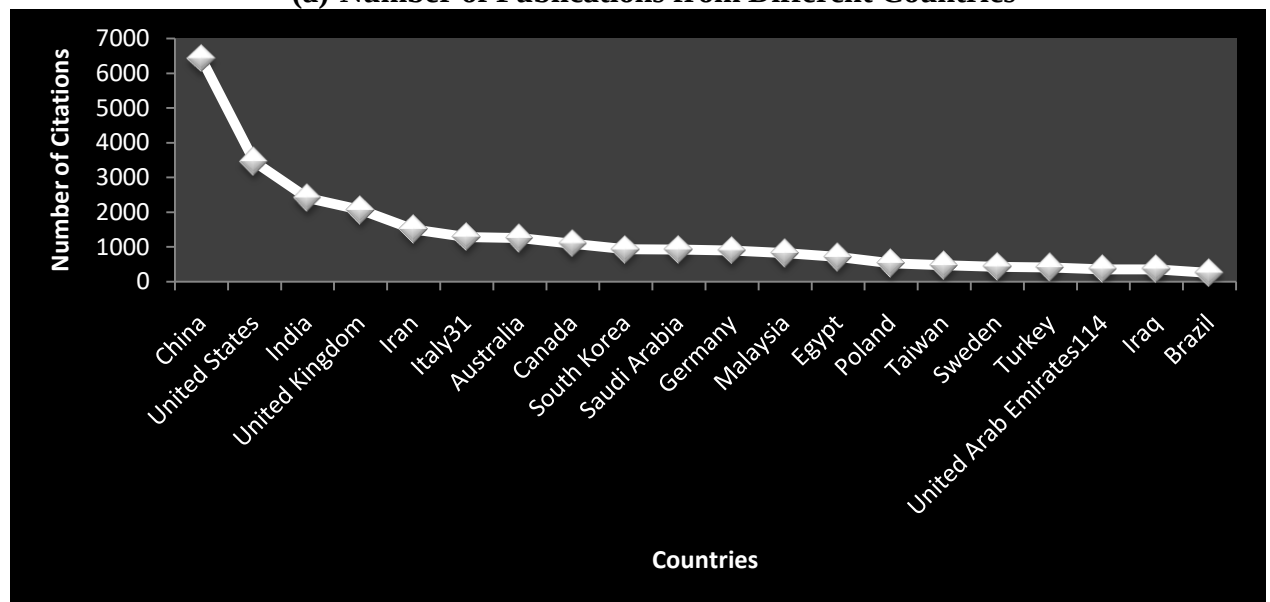
Table 2.1: Number of Publications and Citations for Different Countries in last ten years

S. No	Rank	Country	Number of Publications	Rank	Country	Number of Citations
1.	1	China	738	1	China	6417
2.	2	United States	371	2	United States	3445
3.	3	India	272	3	India	2403
4.	4	United Kingdom	159	4	United Kingdom	2061
5.	5	Iran	152	5	Iran	1502
6.	6	Saudi Arabia	130	6	Italy	1286
7.	7	South Korea	129	7	Australia	1254
8.	8	Italy	114	8	Canada	1090
9.	9	Germany	96	9	South Korea	930
10.	10	Australia	93	10	Saudi Arabia	922
11.	11	Poland	92	11	Germany	898
12.	12	Malaysia	87	12	Malaysia	822
13.	13	Canada	87	13	Egypt	710
14.	14	Turkey	73	14	Poland	526
15.	15	Taiwan	71	15	Taiwan	476
16.	16	Egypt	60	16	Sweden	424
17.	17	Brazil	55	17	Turkey	412
18.	18	Iraq	51	18	United Arab Emirates114	355
19.	19	United Arab Emirates	39	19	Iraq	354
20.	20	Sweden	31	20	Brazil	253

Figure 2.3 shows the details of results in graphical format.



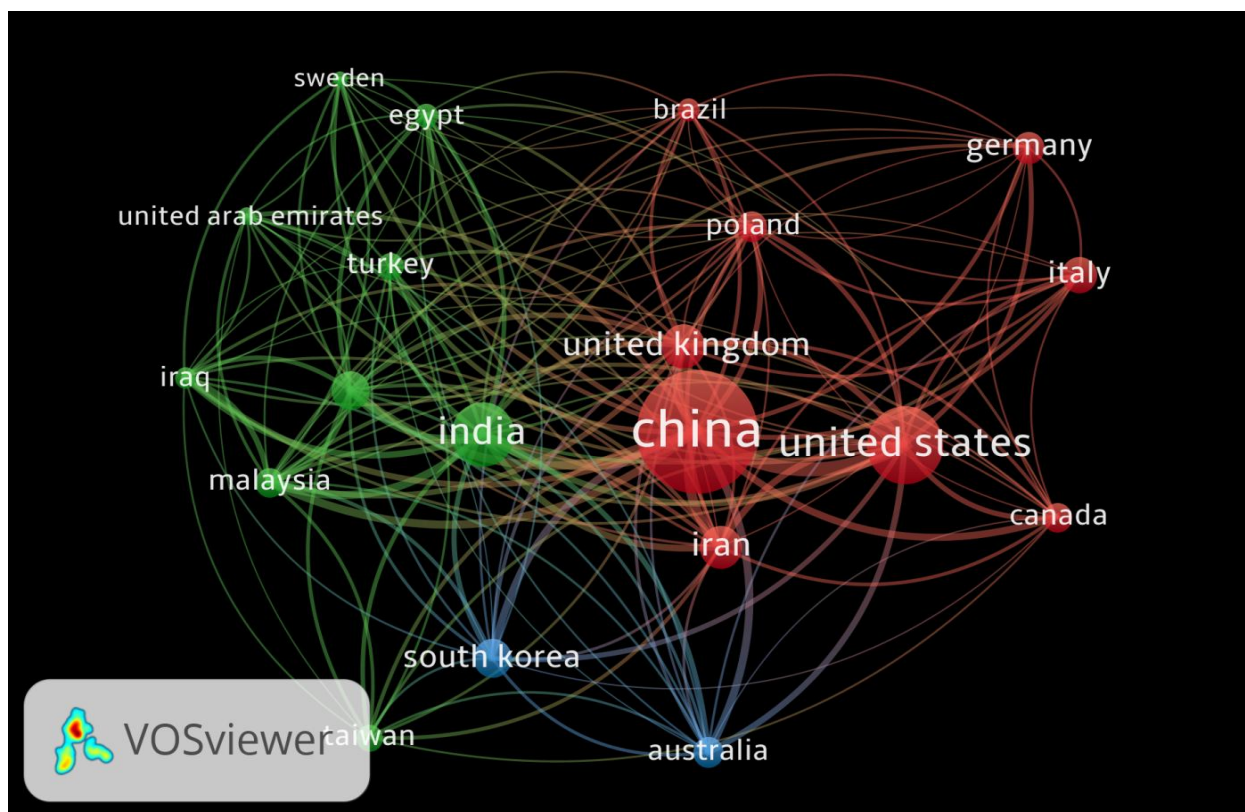
(a) Number of Publications from Different Countries



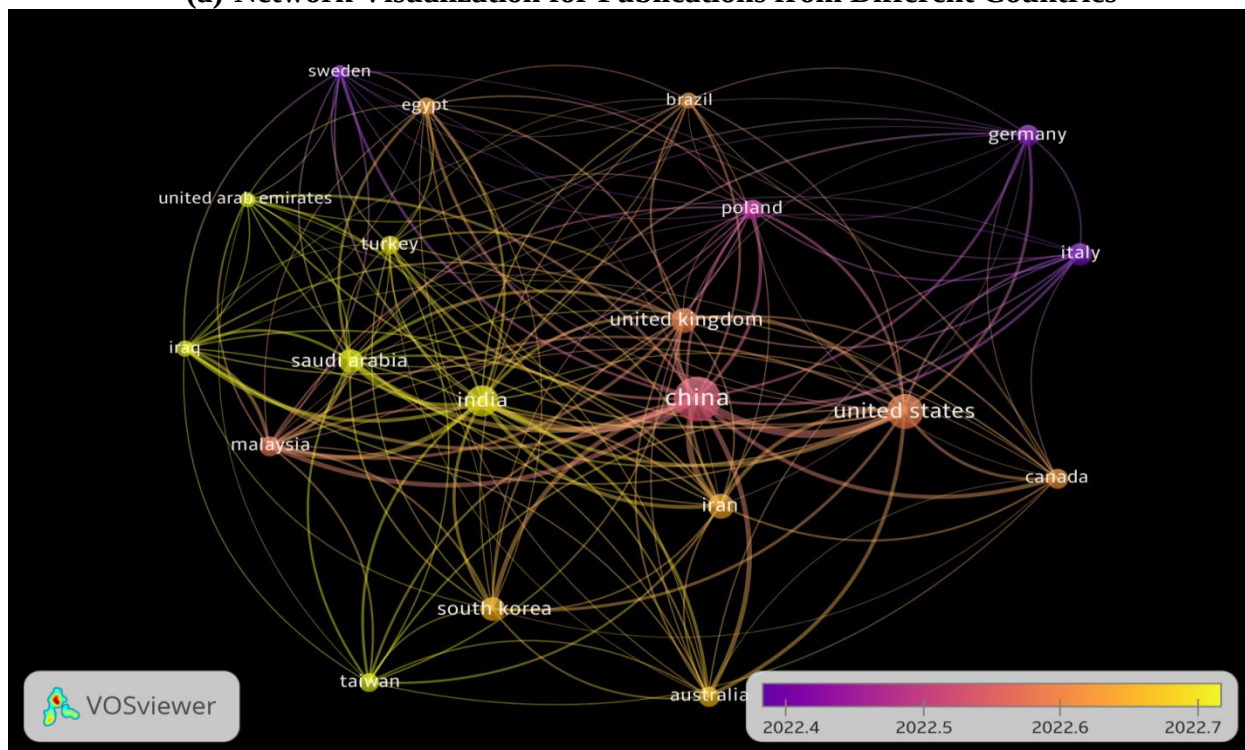
(b) Number of Citations from Different Countries

Figure 2.3: Details of Publications and Citations for Different Countries

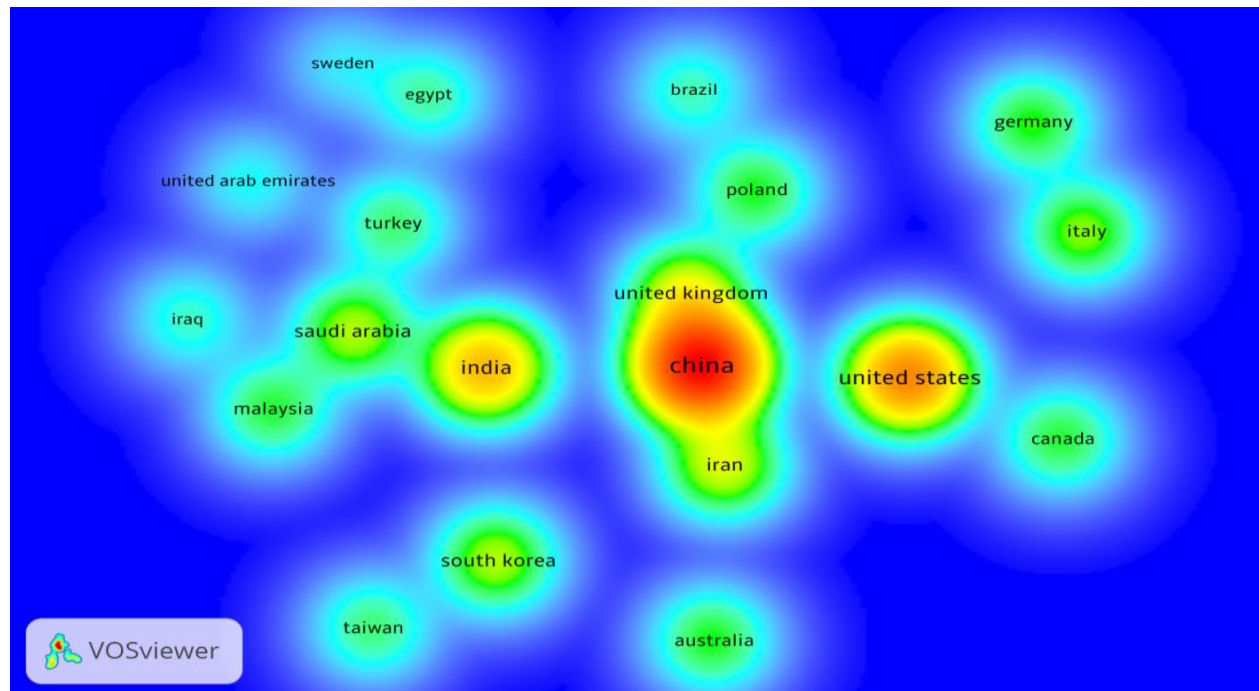
Moving one step further, on drawing network, overlay and density visualizations for above information, the following outputs were obtained.



(a) Network Visualization for Publications from Different Countries



(b) Overlay Visualizations for Publications from Different Countries



(c) Density Visualizations for Different Countries

Figure 2.4: Network, Overlay and Density Visualizations of Research Publications for Different Countries

2.2 Organization wise Publication and Citation Analysis

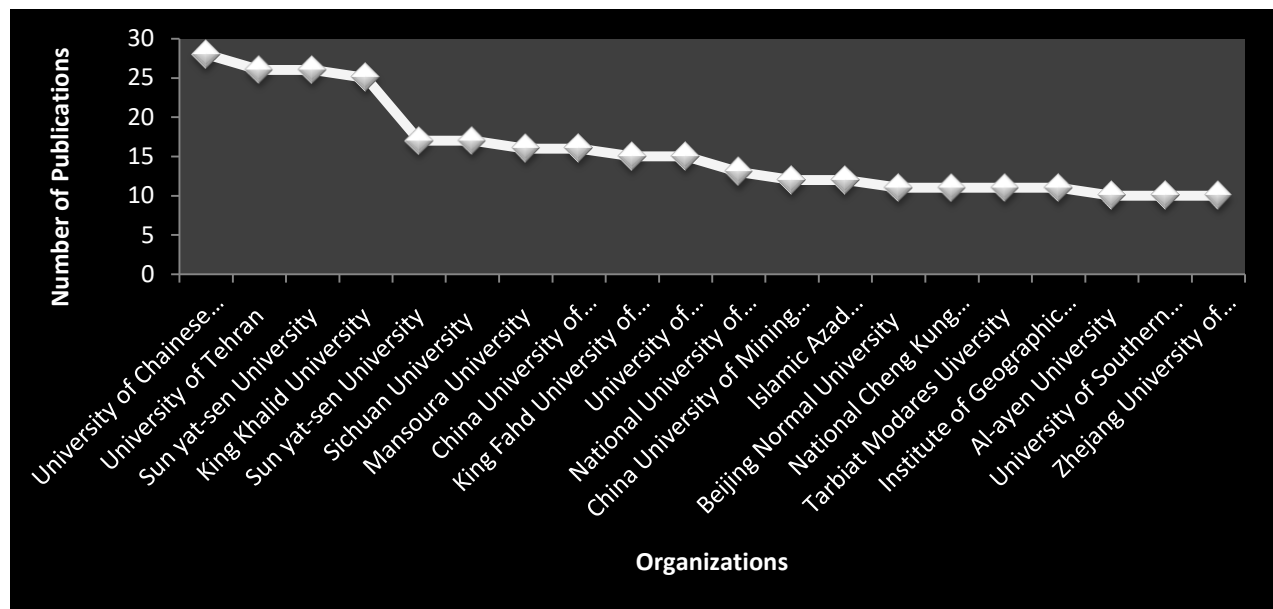
In the next stage, on analyzing the extracted dimensions.ai data in VOSviewer, number of publications as well as citations appeared in last ten years for different organizations were obtained, the details of which are presented Table 2.2 for top twenty alternatives.

Table 2.2: Number of Publications and Citations for Different Organizations in last ten years

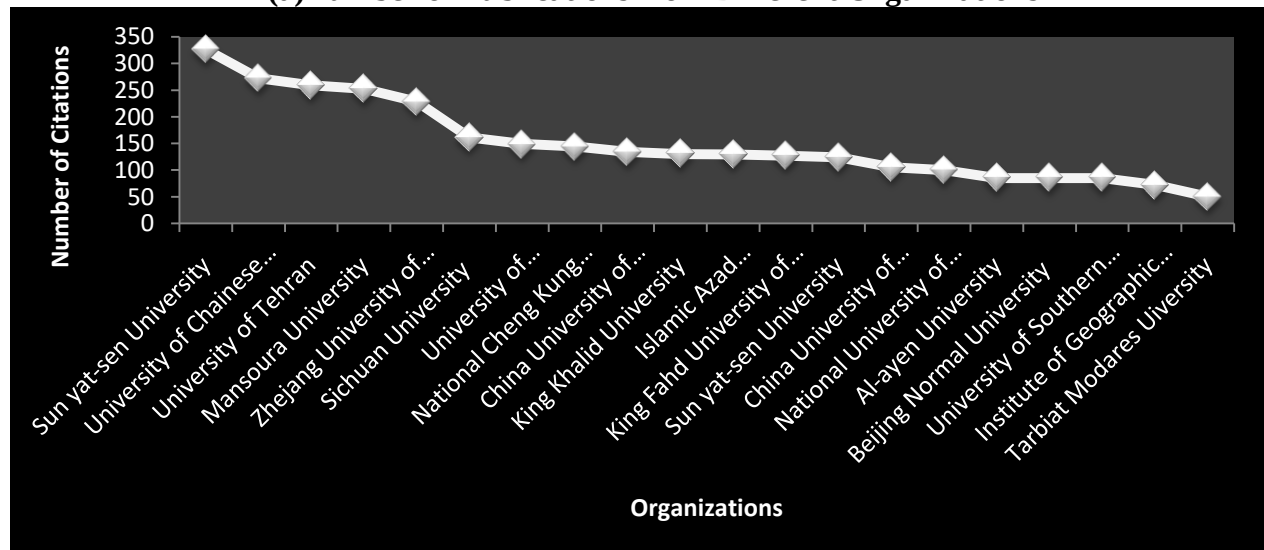
S. No	Rank	Organization	Number of Publications	Rank	Organization	Number of Citations
1.	1	University of Chinese Academy of science	28	1	Sun yat-sen University	326
2.	2	University of Tehran	26	2	University of Chinese Academy of science	272
3.	3	Sun yat-sen University	26	3	University of Tehran	259
4.	4	King Khalid University	25	4	Mansoura University	252
5.	5	Sun yat-sen University	17	5	Zhejiang University of Technology	228
6.	6	Sichuan	17	6	Sichuan University	161

University						
7.	7	Mansoura University	16	7	University of Technology, Malaysia	149
8.	8	China University of Geosciences	16	8	National Cheng Kung University	144
9.	9	King Fahd University of Petroleum and	15	9	China University of Mining and Technology	134
10.	10	University of Technology, Malaysia	15	10	King Khalid University	130
11.	11	National University of Malaysia	13	11	Islamic Azad University, Science and res...	129
12.	12	China University of Mining and Technology	12	12	King Fahd University of Petroleum and	127
13.	13	Islamic Azad University, Science and res...	12	13	Sun yat-sen University	124
14.	14	Beijing Normal University	11	14	China University of Geosciences	105
15.	15	National Cheng Kung University	11	15	National University of Malaysia	100
16.	16	Tarbiat Modares University	11	16	Al-ayen University	85
17.	17	Institute of Geographic Sciences and n....	11	17	Beijing Normal University	85
18.	18	Al-ayen University	10	18	University of Southern Queensland	85
19.	19	University of Southern Queensland	10	19	Institute of Geographic Sciences and n....	72
20.	20	Zhejiang University of Technology	10	20	Tarbiat Modares University	50

Figure 2.5 shows the details of results in graphical format.



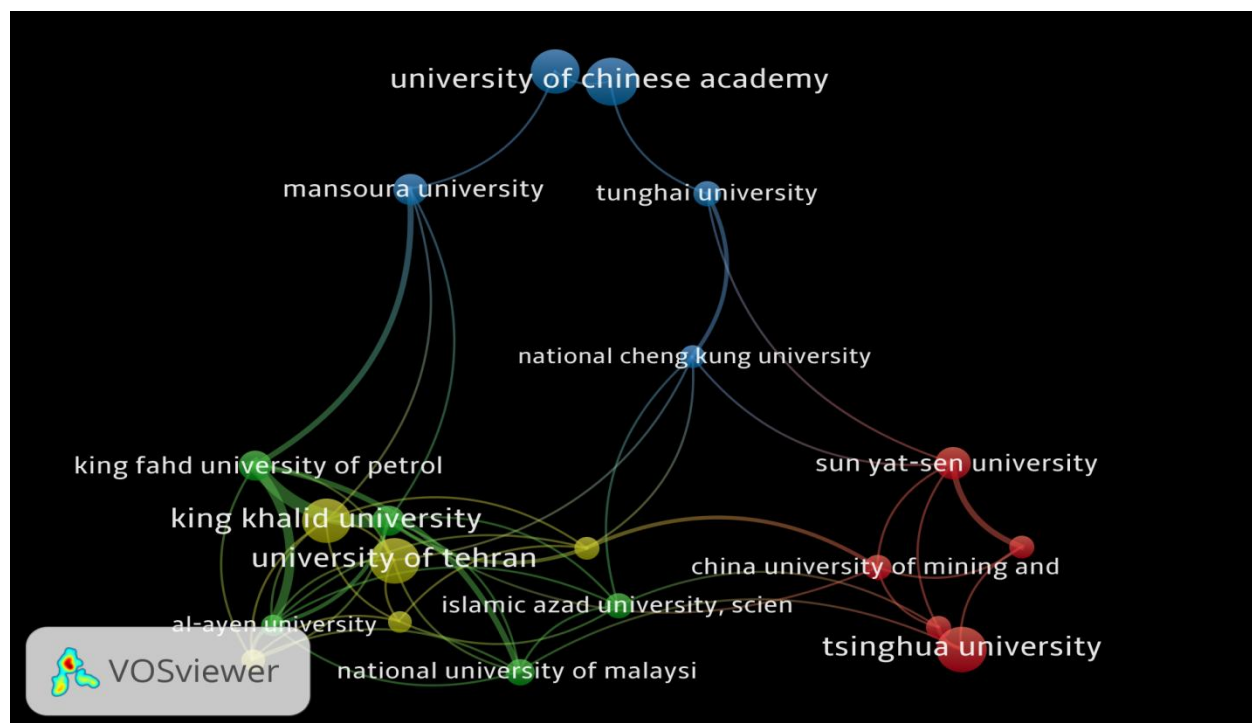
(a) Number of Publications from Different Organizations



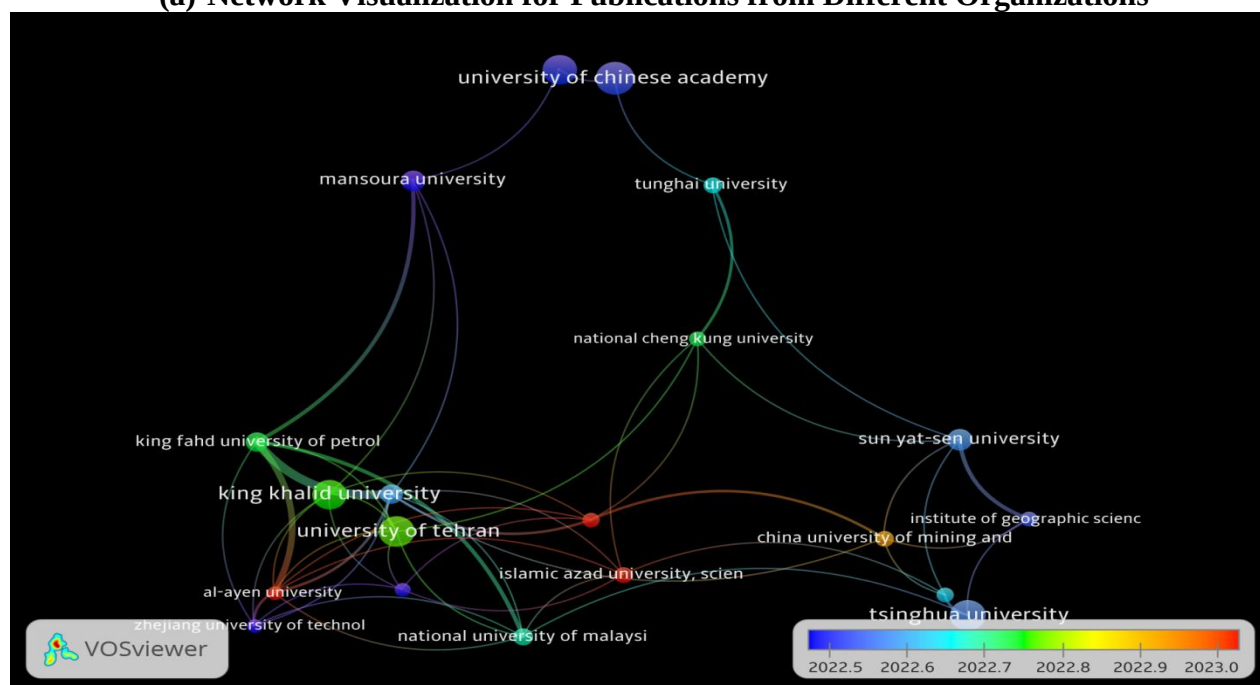
(b) Number of Citations from Different Organizations

Figure 2.5: Details of Publications and Citations for Different Organizations

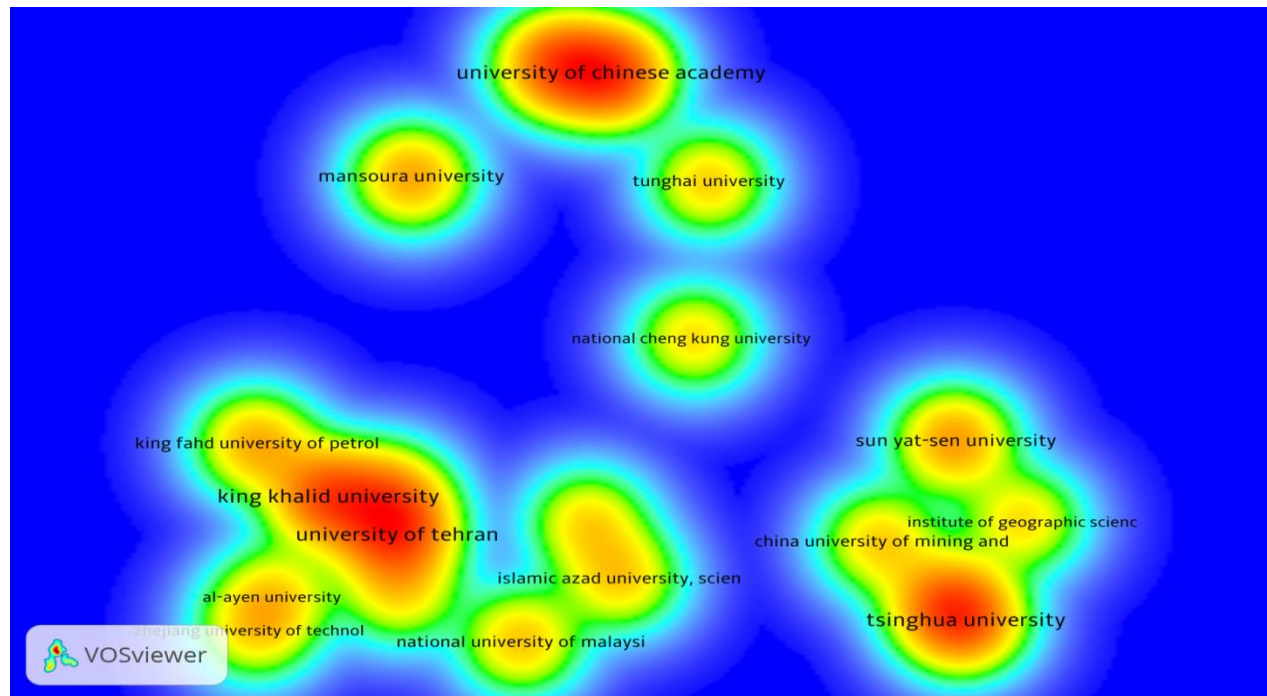
Moving one step further, on drawing network, overlay and density visualizations for above information, the following outputs were obtained.



(a) Network Visualization for Publications from Different Organizations



(b) Overlay Visualizations for Publications from Different Organizations



(c) Density Visualizations for Different Organizations

Figure 2.6: Network, Overlay and Density Visualizations of Research Publications for Different Organizations

2.3 Journals wise Publication and Citation Analysis

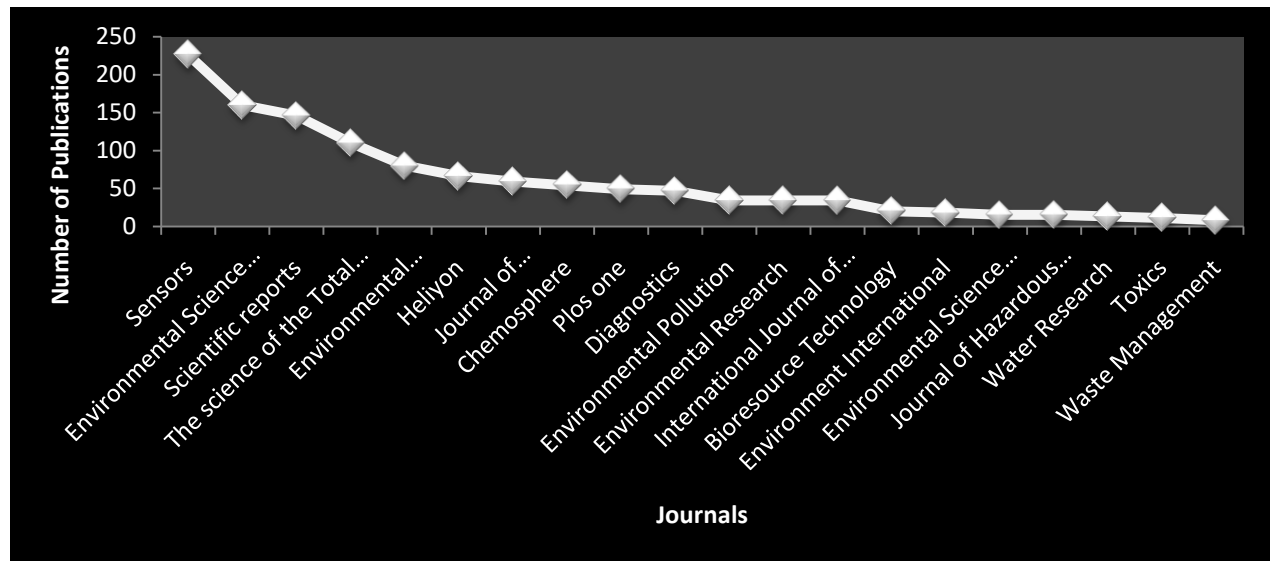
In the next stage, on analyzing the extracted dimensions.ai data in VOSviewer, number of publications as well as citations appeared in last ten years for different Journals were obtained, the details of which are presented Table 2.3 for top twenty alternatives.

Table 2.3: Number of Publications and Citations for Different Journals in last ten years

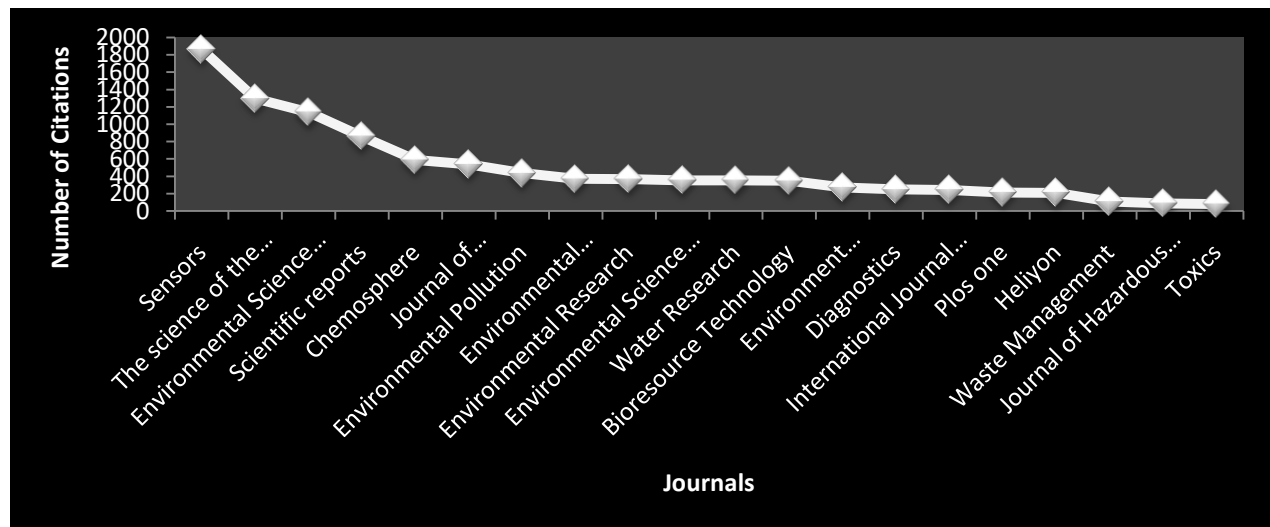
S. No	Rank	Journal	Number of Publications	Rank	Journal	Number of Citations
1.	1	Sensors	226	1	The science of the Total Environment	1299
2.	2	Environmental Science and Pollution Research	160	2	Environmental Science and Pollution Research	1138
3.	3	Scientific reports	146	3	Chemosphere	590
4.	4	The science of the Total Environment	110	4	Scientific reports	860
5.	5	Environmental Monitoring and Assessment	80	5	Environmental Pollution	438
6.	6	Heliyon	66	6	Journal of Environmental	538

Management						
7.	7	Journal of Environmental Management	59	7	Environmental Monitoring and Assessment	372
8.	8	Chemosphere	54	8	Environmental Research	370
9.	9	Plos one	49	9	Environmental Science and Technology	353
10.	10	Diagnostics	47	10	Environment International	272
11.	11	Environmental Pollution	34	11	Sensors	1865
12.	12	Environmental Research	34	12	Bioresource Technology	350
13.	13	International Journal of Environmental Research	34	13	Heliyon	211
14.	14	Bioresource Technology	20	14	Journal of Hazardous Materials	87
15.	15	Environment International	18	15	Toxics	81
16.	16	Environmental Science and Technology	15	16	Water Research	353
17.	17	Journal of Hazardous Materials	15	17	International Journal of Environmental Research	245
18.	18	Water Research	13	18	Waste Management	109
19.	19	Toxics	11	19	Plos one	214
20.	20	Waste Management	8	20	Diagnostics	249

Figure 2.7 shows the details of results in graphical format.



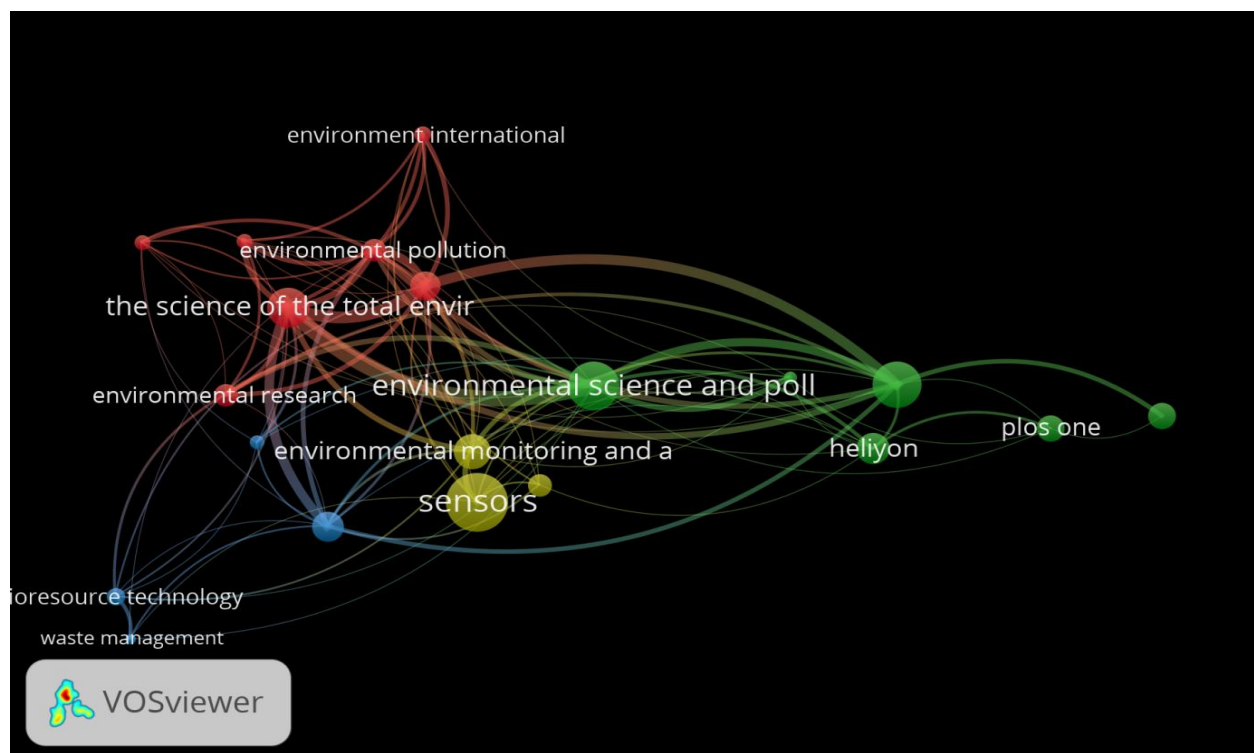
(a) Number of Publications from Different Organizations



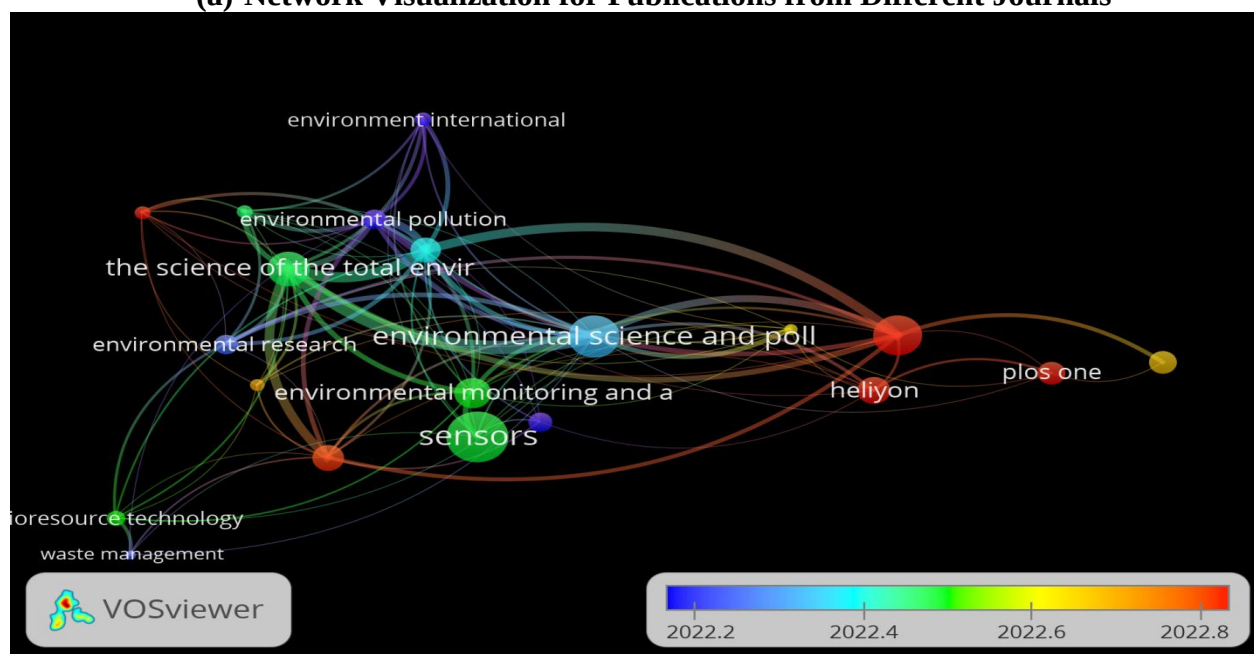
(b) Number of Citations from Different Journals

Figure 2.7: Details of Publications and Citations for Different Journals

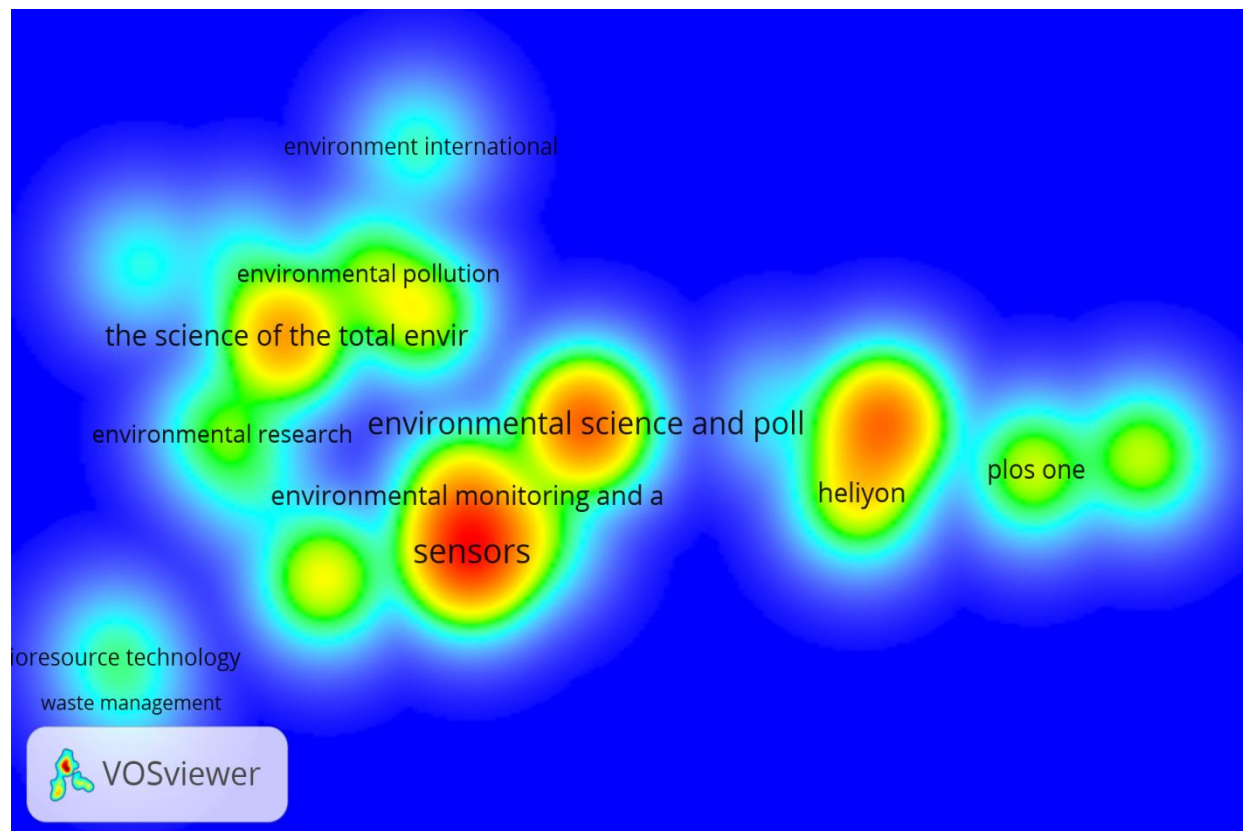
Moving one step further, on drawing network, overlay and density visualizations for above information, the following outputs were obtained.



(a) Network Visualization for Publications from Different Journals



(b) Overlay Visualizations for Publications from Different Journals



(c) Density Visualizations for Different Journals

Figure 2.8: Network, Overlay and Density Visualizations of Research Publications for Different Journals

3. Discussion

Bibliometrics analysis highlights many important aspects regarding demographic and academic aspects of the research publications in last ten years. It also tells about the propagation of research activities, with time, which can be visualized from Figure 2.1, which tells about the development of research publication activities from 10,000 in 2015 to 42,500 in 2023, which is more than 400 percent, and can be treated as a developed research oriented environment. Plus, from Figure 2.2, it can also be visualized that the almost every stream of higher education has contributed in the desired field, which may be treated as a good sign of overall research in the field of air quality assessment using ANN approach.

On investigating for number of publications and citations for different countries in the last ten years, it was found that, China scored the rank 1 for the criteria, number of publications (738), and number of citations (6417), while United States scored rank 2 with 371 publications and 3445 citations. India has secured rank 3, with 272 research publications and 2403 citations; whereas UK scored rank four with 159 research publications, and 2061 citations. Proceeding in the same manner, Iran has scored rank 5 with 152 research publications and 1502 citations. Proceeding in the similar manner, research publications and citations based rankings of top 20 countries were investigated, and based on these data; network visualizations, overlay

visualizations and density visualizations of different countries were drawn, which showed the details of linkages among the countries their publication years and their origins.

In the next step of Bibliometrics analysis, details of publications and citations for top 20 organizations were investigated. Results of the research work showed that University of Chinese Academy of Science published 28 research publications and scored rank 1 where as Sun-yat-university provided 326 citations, and earned the rank 1. Proceeding in the similar manner rankings of different universities/institutes were investigated, for both, number of research publications and number of citations. The results were also drawn, with the help of line graphs; organizations vs number of research publications, and organizations vs number of citations. In the similar manner, network visualizations for different organizations, overlay visualizations for different organizations as well as density visualizations for different organizations were drawn, which showed the details of linkages among the organizations, their publication years and their origins.

In the last step of the research work, top 20 journals for number of publications and citations were also listed. The results showed that none of the journals scored common rankings on both of the criteria. The results were also drawn, with the help of line graphs for journals vs number of research publications, and journals vs number of citations. In the similar manner, network visualizations for different organizations, overlay visualizations for different organizations as well as density visualizations for different organizations were drawn, which showed the details of linkages among the sources, their publication years and their origins.

4. Conclusion, Limitations and Future Scope of the Research

The present section focuses on the details of conclusion, limitations and future scope of the research work:

4.1 Conclusion

Following points represent the conclusion of the research work:

- a) In last ten years, a remarkable progress in the research activities has been noticed in the field of assessment of air quality using artificial neural networks;
- b) In last three years the research on assessment of air quality has increased in China, United states and India, as these countries has scored first three ranks in the list of countries for greatest number of publications and citations;
- c) European and Asian countries showed the greater amount of research in the field of assessment of air quality using ANN;
- d) India has also shown considerable achievements considering number of publications, citations;
- e) Asian universities has shown greater amount of research in the field of assessment of air quality using ANN;
- f) In the last ten years, different environmental and sustainability journals have shown considerable number of publications as well as the authors has reported a good number of citations for the keywords, assessment of air quality using ANN.

4.2 Limitations and Future Scope of the Research Work

Following points represent the limitations of the research work:

- a) The present research work was conducted for finite number of countries and for a tenure of 10 years only; and
- b) The research work was also made limited by considering limited number of organizations and research journals.

Following points represent the future scope of the Research

- a) An extensive research can be conducted considering a broader set of countries and for a greater tenure; and
- b) A great research may also be initiated considering a broader set of organizations as well as research journals.

References and Web Resources

- Asha, P., Natrayan, L., Geetha, B. T., Beulah, J. R., Sumathy, R., Varalakshmi, G., & Neelakandan, S. (2022). IoT enabled environmental toxicology for air pollution monitoring using AI techniques. *Environmental research*, 205, 112574.
- Goyal, P., & Kumar, A. (2011). Mathematical modeling of air pollutants: an application to Indian urban city. *Air Quality-Models and Applications*.
- Ke, H., Gong, S., He, J., Zhang, L., Cui, B., Wang, Y. & Zhang, H. (2022). Development and application of an automated air quality forecasting system based on machine learning. *Science of The Total Environment*, 806, 151204.
- Liu, C. C., Lin, T. C., Yuan, K. Y., & Chiueh, P. T. (2022). Spatio-temporal prediction and factor identification of urban air quality using support vector machine. *Urban Climate*, 41, 101055.
- Mahendra, H. N., Mallikarjunaswamy, S., Kumar, D. M., Kumari, S., Kashyap, S., Fulwani, S., & Chatterjee, A. (2023). Assessment and Prediction of Air Quality Level Using ARIMA Model: A Case Study of Surat City, Gujarat State, India. *Nature Environment & Pollution Technology*, 22(1).
- Mishra, A., & Gupta, Y. (2024). Comparative analysis of Air Quality Index prediction using deep learning algorithms. *Spatial Information Research*, 32(1), 63-72.
- Mishra, D., & Goyal, P. (2016). Neuro-fuzzy approach to forecast NO₂ pollutants addressed to air quality dispersion model over Delhi, India. *Aerosol and air quality research*, 16(1), 166-174.
- Nigam, S., Nigam, R., & Kapoor, S. (2013). Modelling and Simulation of Ambient Carbon Monoxide. *International Journal of Engineering and Advanced Technology*, 3.
- Sekar, C., Ojha, C. S. P., Gurjar, B. R., & Goyal, M. K. (2016). Modeling and prediction of hourly ambient ozone (O₃) and oxides of nitrogen (NO_x) concentrations using artificial neural network and decision tree algorithms for an urban intersection in India. *Journal of hazardous, toxic, and radioactive waste*, 20(4), A4015001.
- www.dimensions.ai retrieved on 25th March, 2024.