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# Bibliometric Survey on Effects of Climate Change on Incidences of Infectious Diseases

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## ABSTRACT

For understanding the influx of Infectious Diseases, research of climate change and its effects pertaining to the diseases is important. The motive of this bibliometric survey is to understand the research which has been carried out regarding the aforementioned topics. This paper summarizes the research in the 21st Century from 2001 to present. We conducted this analysis using tools such as Gephi, Researchgate, Scopus, ScienceScape, Google Scholar and Mapchart.

This Bibliometric Survey on "Effects of Climate Change on Infectious Diseases" showed that maximum publications are articles. These publications are from conferences and journals related to Environmental Science. The United States leads these publications followed by Australia and China. Medicine and Environmental Science are the most contributing subjects to the topic.

## 1. INTRODUCTION

Climate Change is a change in the average conditions like temperature and rainfall in an area over a long period of time. The term 'Global Climate Change' is about the overall long-term changes on the planet.

Climate Change occurs due to two main activities - Natural activities and Human activities.

Natural activities include variations in the Sun and calamities such as Volcanic eruptions. Human activities include emission of Carbon-di-oxide and other Greenhouse gases leading to Global Warming.

Global Climate change has had overt effects on the environment. Glaciers and ice on the sea,rivers and lakes are melting, the lifestyles of the vegetation and animals have changed. The planet is warming from the North Pole to the South Pole. The heat is melting glaciers, shifting precipitation patterns, setting animals on the move to change their habitats. Climate change has different effects at different types of locations and terrain, and it will affect differently on them. The increasing melting of Glaciers causes the Seawater levels to rise, which eventually results in an increased risk of waterborne diseases in the coastal areas. The flood-prone, drought-prone areas indirectly lead to food and water contamination which creates outbreaks of all types of infectious diseases. The magnitude of a disease outbreak depends upon various parameters such as living conditions, overall cleanliness, terrain, presence of water bodies and weather conditions.

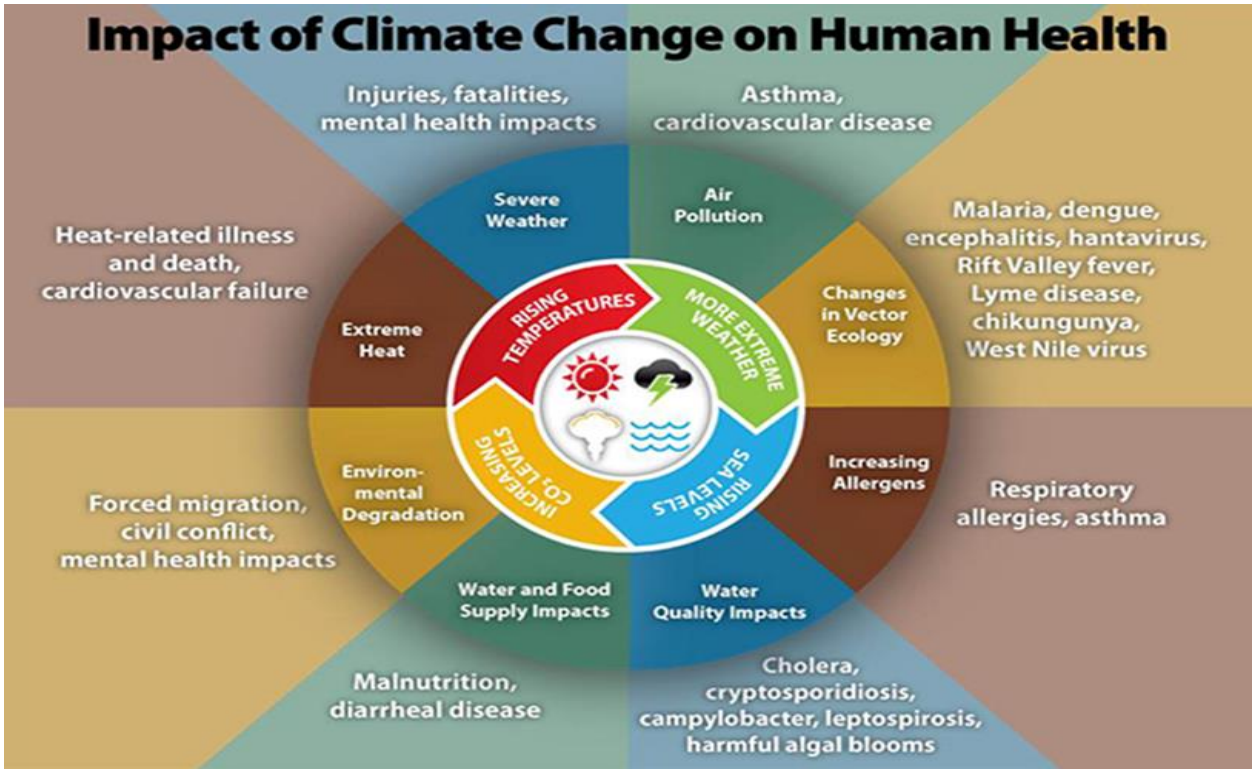


Figure1: Climate Change Health Impacts on Humans

Source: CDC

## 2. PRELIMINARY DATA COLLECTION

For writing a Bibliometric paper, we need to collect information from a reliable database of publications. There are many convenient ways to retrieve data required from the databases. The most commonly used Research paper Directories are Google Scholar, ResearchGate, Scopus, Mendeley, ScienceDirect etc. Scopus is an enormous abstract and citation database of research literature in the STEM fields as well as medicine, social sciences, arts, and humanities.

### 2.1. Significant Keywords

While extracting data it is important to input the proper keywords to get the most relevant results. The pivotal keywords related to Climate Change and Infectious Diseases were divided into 2 compartments. The table below shows the keywords we used to generate results.

| | |
|---|---|
| Master - Keyword | “Climate Change, Disease” |
| Primary - Keyword (AND) | “Analyze” OR “Data” |

*Table 1: Planned Search Tactics*

### 2.2. Search Statistics

The Scopus Directory is the main database of this Bibliometric paper. Initial research via keyword search tactics showed 213 publication results. These results are summarized by language in a tabular format to help other researchers find relevant papers or research gaps in their own language.

| **Sr No.** | **Publication Language** | **Number of Publications** |
|---|---|---|
| 1 | English | 191 |
| 2 | Chinese | 9 |
| 3 | German | 4 |

| | | |
|---|---|---|
| 4 | Russian | 3 |
| 5 | Persian | 2 |
| 6 | Portugese | 2 |
| 7 | Spanish | 2 |
| 8 | Czech | 1 |
| 9 | Moldavian | 1 |
| 10 | Moldavan | 1 |
| 11 | Romanian | 1 |
| 12 | Turkish | 1 |
| Total | | 213 |

Table 2: Publishing Language Trends

Source: http://www.scopus.com (Retrieved on 6th December 2020)

All kinds of published and unpublished papers were taken into consideration. It was found that the majority of the papers were published in Journals with a percentage of 92.0 1. The rest of the papers were divided between conference proceedings, books, book series.

| **Publication Type** | **Number of Publications** | **Percentage of 213** |
|---|---|---|
| Journal | 196 | 92.01% |
| Conference Proceedings | 10 | 4.69% |
| Book | 5 | 2.35% |
| Book Series | 2 | 0.95% |
| Total | 213 | 100% |

Table 3: Publishing Types

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 2.3. Highlights of the Data

The papers procured as articles, conference papers, reviews, etc. for the span of 21 years from 2001-2021. Year wise table and graph was generated to analyse whether there was an increase in publications as the years passed. It is clearly observed that in the span of 20 years the number of publications has increased from 1 per year to 36 publications a year.

| **Year** | **Publications Count** |
|---|---|
| 2001 | 1 |
| 2002 | 1 |
| 2003 | 2 |
| 2004 | 0 |
| 2005 | 1 |
| 2006 | 3 |
| 2007 | 6 |
| 2008 | 4 |
| 2009 | 5 |
| 2010 | 9 |
| 2011 | 9 |
| 2012 | 5 |
| 2013 | 12 |
| 2014 | 16 |
| 2015 | 11 |

| | |
|---|---|
| 2016 | 19 |
| 2017 | 19 |
| 2018 | 23 |
| 2019 | 30 |
| 2020 | 36 |
| 2021 | 1 |

Table 4: Trends for Yearly Publishing

Source: http://www.scopus.com (Retrieved on 6th December 2020)

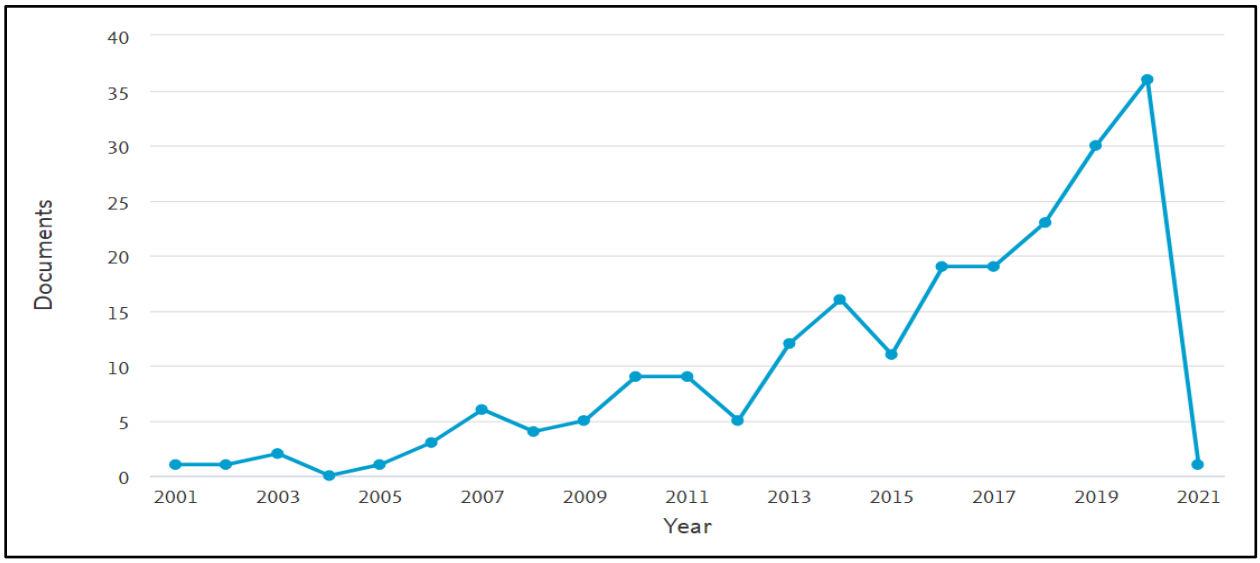


Figure 2: Trends for Yearly Publishing

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3. ANALYSIS OF BIBLIOMETRY

To perform a Bibliometric Analysis of Effects of Climate change on Incidences of Infectious Diseases, the following two ways are applied -

1. Geographic Region, Network and Citation Analysis
2. Keyword, Affiliation, Author and Journal Statistics

### 3.1 Analysis of the Geographic Region

The figure shown below is drawn to help researchers understand what countries publish the most papers relevant to the topic so that they can narrow down their search based on country filters. This figure is drawn using Mapchart.net showing top 10 countries that have published papers related to Climate Change and Diseases.

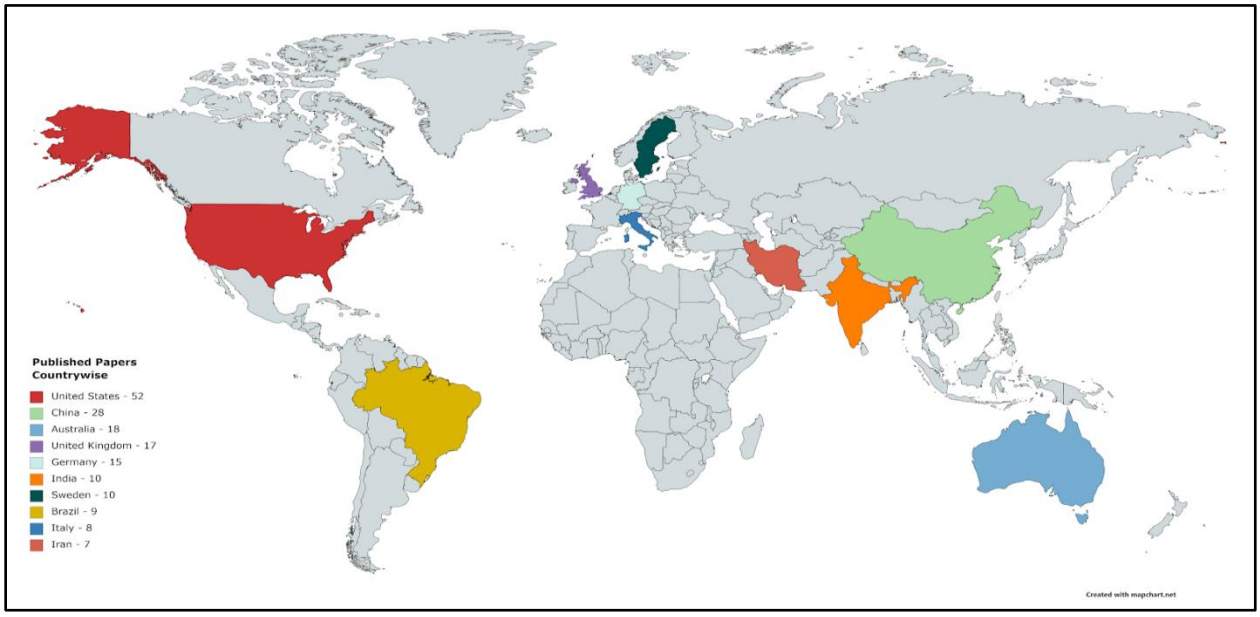


Figure 3: Geographical Locations of Published Papers

Source: http://www.scopus.com (Retrieved on 6th December 2020)

The next figure shows the same data in a graphical format. It is clear that the USA is leading the research with 52 papers, with Iran being at the 10th position with 7 papers.

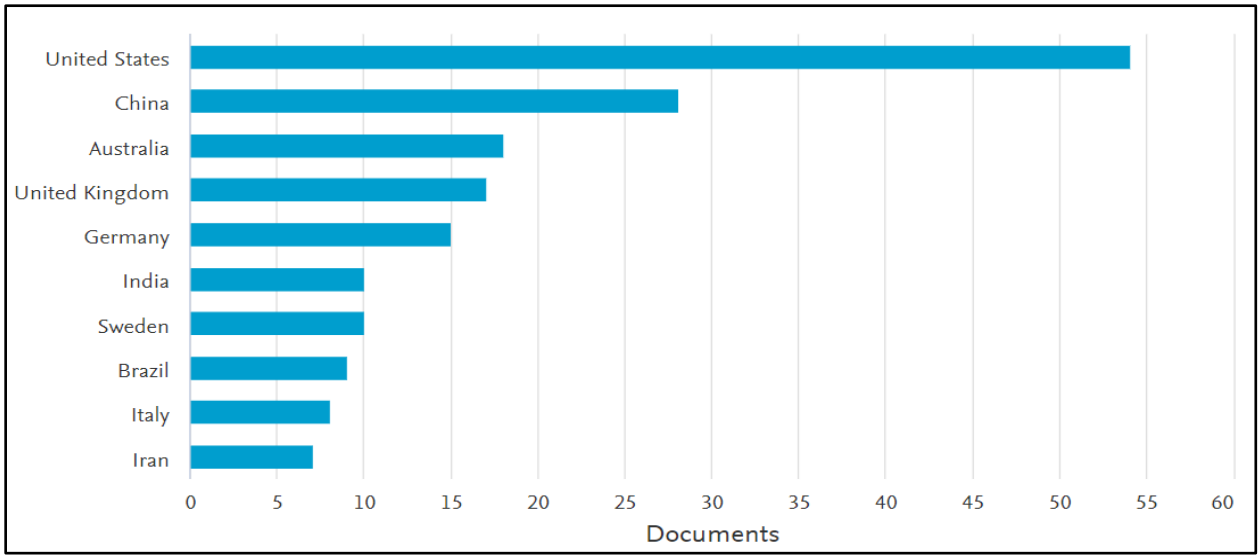


Figure 4: Published Papers Country wise

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3.2 Statistics of the Keywords

Keywords indicate what the researcher wants to look up. The correct combination of keywords help to target remarkable areas of research. Not using the correct keywords might lead to incomplete or inaccurate results. The most repetitive 15 keywords pertaining to our topic are listed in the table below.

| **Keywords** | **No. of Publications** |
|---|---|
| Human/Humans | 201 |
| Climate Change | 139 |
| Article | 100 |
| Season/Seasons | 62 |
| Temperature | 54 |
| Female | 53 |
| Male | 50 |
| Adult | 36 |
| Seasonal Variation | 36 |
| Incidence | 35 |
| Major Clinical Study | 35 |
| Priority Journal | 35 |
| Climate | 34 |
| Animals | 29 |
| Risk Factor | 20 |

Table 5: Top 15 Keywords

Source: http://www.scopus.com (Retrieved on 6th December 2020)

### 3.3. Analysis of the Network

The relationships between multiple statistical parameters are visualized graphically using Network Analysis. ScienceScape is an open-source website which is used to convert the Scopus database into a network based on specific parameters. This network is then enhanced in Gephi, which is another open-source software using different layouts such as Fruchterman Reingold etc.

This figure below shows the relationship between the Source Titles and Author Keywords.

It gives researchers an idea of the keywords used by the best authors in the field and how these keywords are used in the context of the sources they are published in.

It is clearly observed that there are two important data clusters which are “Climate Change” and “Temperature”. The network has 119 junctions and 217 links.

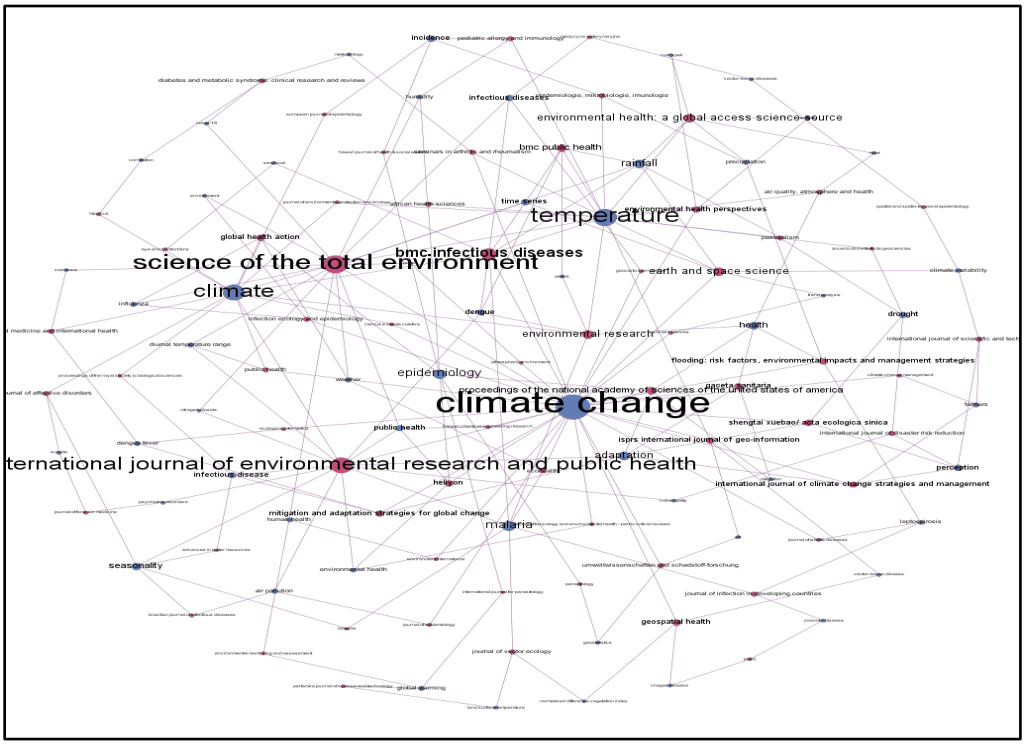


Figure 5: Network of Source Titles and Keywords used by Author

Source: http://www.scopus.com (Retrieved on 6th December 2020)

The figure below visualizes clusters of Authors and the Authors' Keywords occuring in the same publication. It gives us an idea of the common keywords used by the different authors. The network has 1498 junctions and 4659 links.

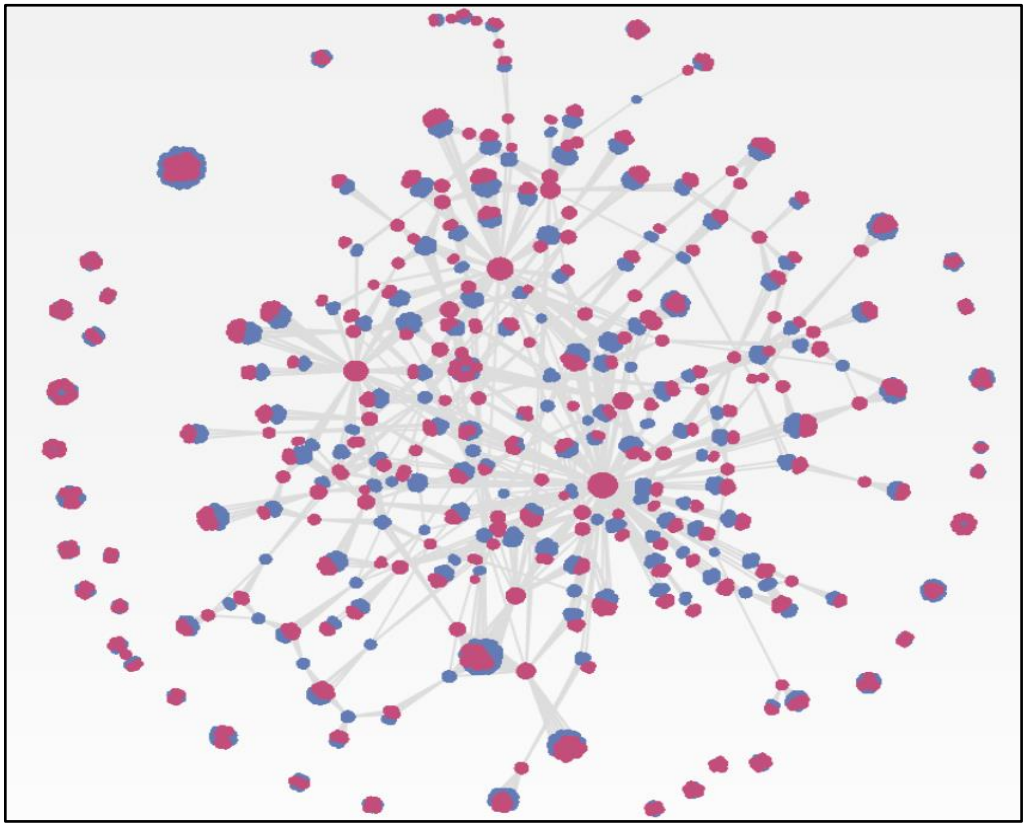

Figure 6: Network of Author and their Keywords

Source: http://www.scopus.com (Retrieved on 6th December 2020)

The figure below shows the relationship between Authors and Source Titles. The majority of Authors have written in two sources which are 'International Journal of Environment Research and Public Health' and 'Science of the total environment'. This gives us an idea about what sources the authors prefer. With the help of these results, other researchers can target the same sources for better chances of publication. The network has 1174 junctions and 1040 links.

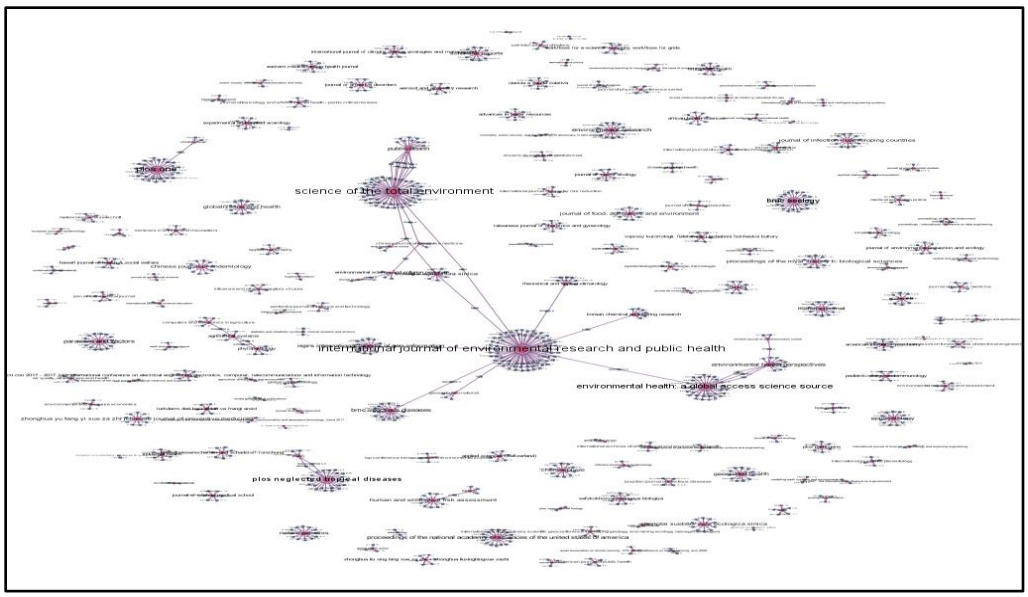


*Figure 7: Network of Author and Source Titles*

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3.4 Subject Areas

This figure was drawn using metachart.com. The figure below describes Subject area wise classification for the publications retrieved. It is clear that most of the research relevant to climate change and diseases is carried out in Medicine with Environmental Science being a close second. This figure helps the researchers understand the most relevant subject areas for the given topic. Using this figure, researchers can also find research gaps in their own subject areas which they can improve upon.

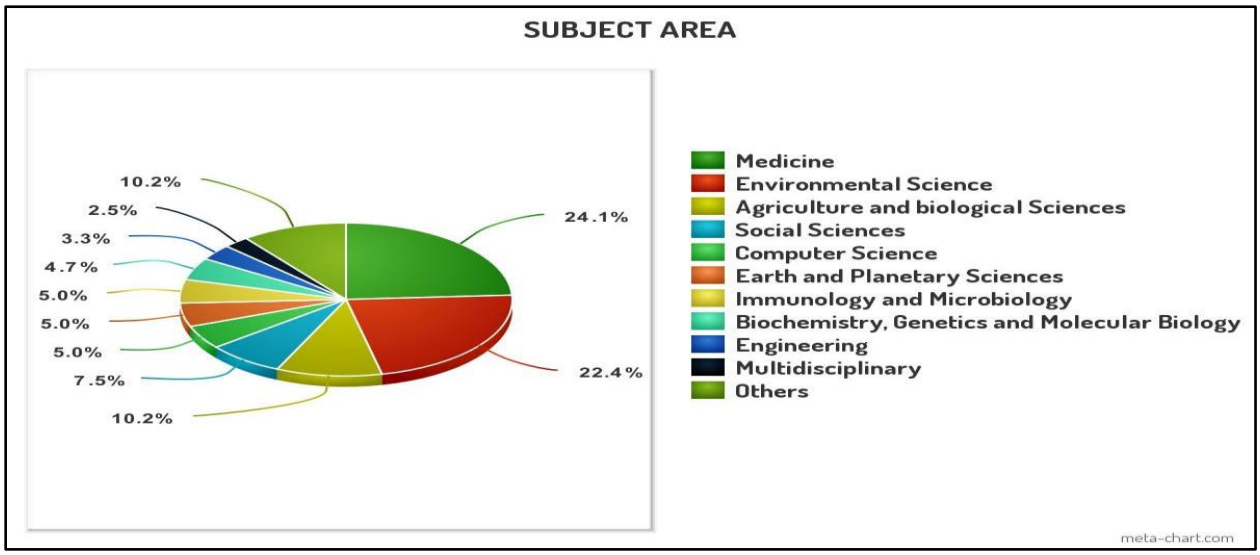


*Figure 8: Subject Areas*

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3.5 Statistics of the Affiliations

The figure below shows the top 10 Universities / Organizational affiliations that have contributed to the topic.. The 'Climate Change and its impact on disease spread' has been a topic of research in Australia, Denmark and China with 5 publications each. Using this figure, student researchers can target specific universities for their future studies based upon the subject area they want to research in.

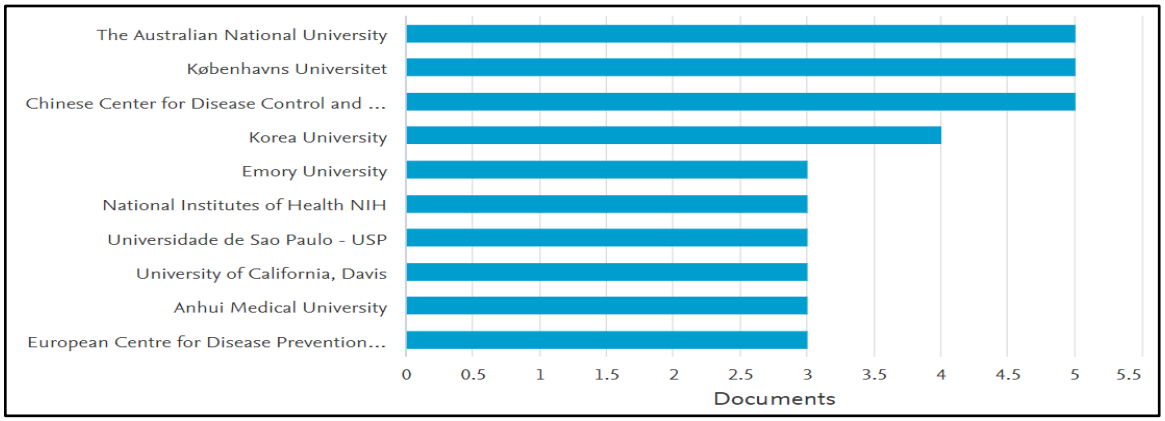


Figure 9: Documents by Affiliation

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3.6 Author Contributions

The chart below shows the most contributing Authors publishing about Climate Change and Diseases. Using this figure, fellow researchers can target specific authors based upon the number of research papers they have written. This can help to narrow down their scope of search to generate relevant results.

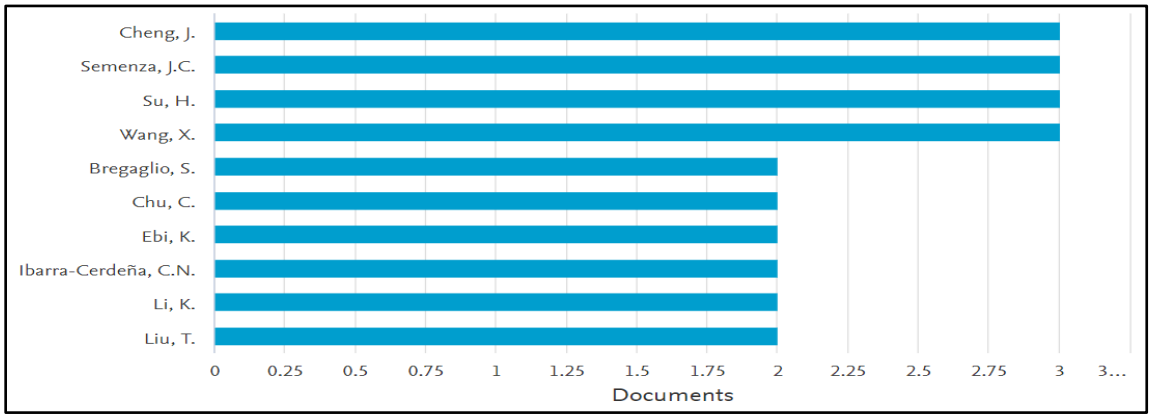


Figure 10: Top Authors

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3.7 Statistics of the Journals

The figure below shows the types of publications in the area of Climate Change and Diseases. The extracted data shows that 83.6 % publications are articles. It is also observed that conference papers and reviews together make up 12.2 % of the total publications. This figure can help researchers decide the type of paper they want to publish and refer to their specific type.

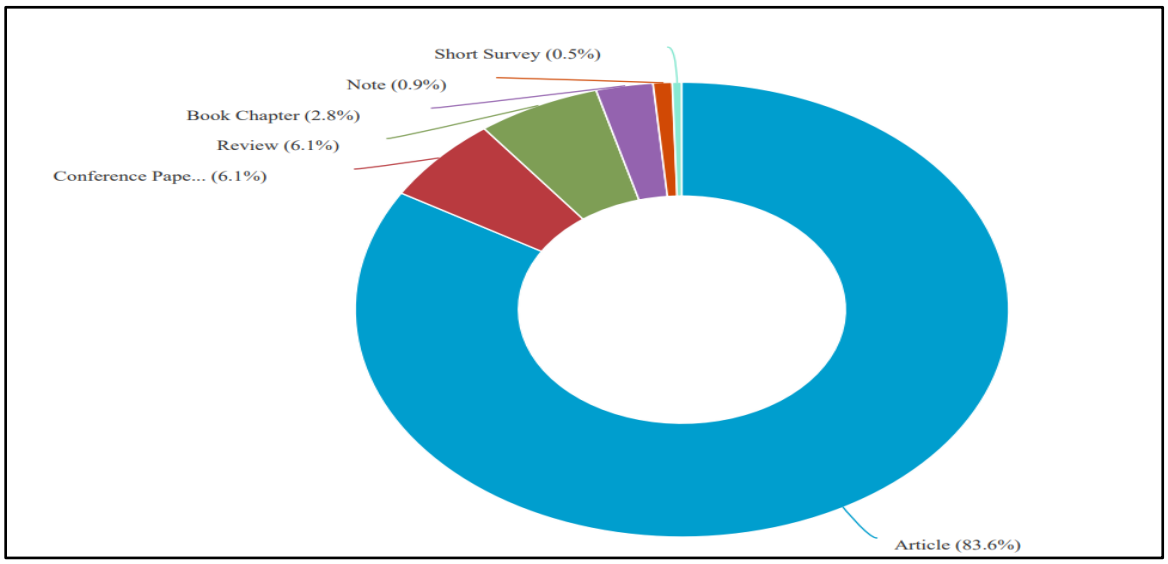


Figure 11: Document Types

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 3.8 Analysis of the Citations

The table below displays year-wise citations of publications retrieved about Climate change and Diseases. The total citations of 213 publications are 4219 until 2020. This table can be used to target specific papers based upon the years they are cited in.

| **Year** | <2015 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|---|
| **No of Citations** | 1228 | 327 | 362 | 412 | 455 | 520 | 915 | 4219 |

Table 6: Yearwise Citation Analysis

Source: http://www.scopus.com (Retrieved on 6th December 2020)

The next table displays the first 10 papers along with the number of times they are cited. The table can help signify the best papers in the relevant topics based on the number of citations

they have received. This means that these papers were the most referenced papers in different publications which signifies the importance of these papers.

| **Publication Title** | **Yearly Citations Received by the Publications** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | <2015 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
| The association between extreme precipitation and waterborne disease outbreaks in the United States, 1948-1994 | 381 | 43 | 50 | 34 | 34 | 45 | 36 | 623 |
| Carbon sequestration in tropical agroforestry systems. | 195 | 23 | 35 | 35 | 51 | 26 | 43 | 408 |
| Zoonosis emergence linked to agricultural intensification and environmental change. | 25 | 37 | 35 | 41 | 39 | 39 | 65 | 281 |
| A worldwide survey of genome sequence variation provides insight into the evolutionary history of the honey bee, Apis mellifera. | 1 | 19 | 30 | 27 | 24 | 23 | 36 | 160 |
| Local impact of temperature and precipitation on West Nile virus infection in Culex species mosquitoes in northeast Illinois, USA. | 68 | 13 | 18 | 12 | 15 | 16 | 17 | 159 |
| Cigarette smoking in relation to depression : Historical trends from the Stirling County Study. | 113 | 7 | 10 | 4 | 2 | 1 | 0 | 137 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Correlation between weather and Covid-19 pandemic in Jakarta, Indonesia. | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 124 |
| Increasing water temperature and disease risk in aquatic systems: Climate Change increases the risk of some, but not all diseases. | 26 | 13 | 12 | 14 | 12 | 12 | 21 | 110 |
| Modelling the impact of pests and diseases on agricultural systems. | 0 | 0 | 0 | 6 | 17 | 28 | 37 | 88 |
| Weather, water quality and infectious gastrointestinal illness in two communities Nunatsiavut, Canada: Potential implications for climate change. | 21 | 14 | 4 | 10 | 12 | 9 | 11 | 81 |

Table 7: Yearly Citations received by Publications

Source: http://www.scopus.com (Retrieved on 6th December 2020)

### 3.9 Source Statistics

From the source statistics shown below, it is observed that the most of the publications are done in 2019 by the International Journal of Environmental Research and Public Health. This figure gives an idea about what sources most papers are published in. This can help researchers narrow down their scope of search based on source statistics to generate relevant results.

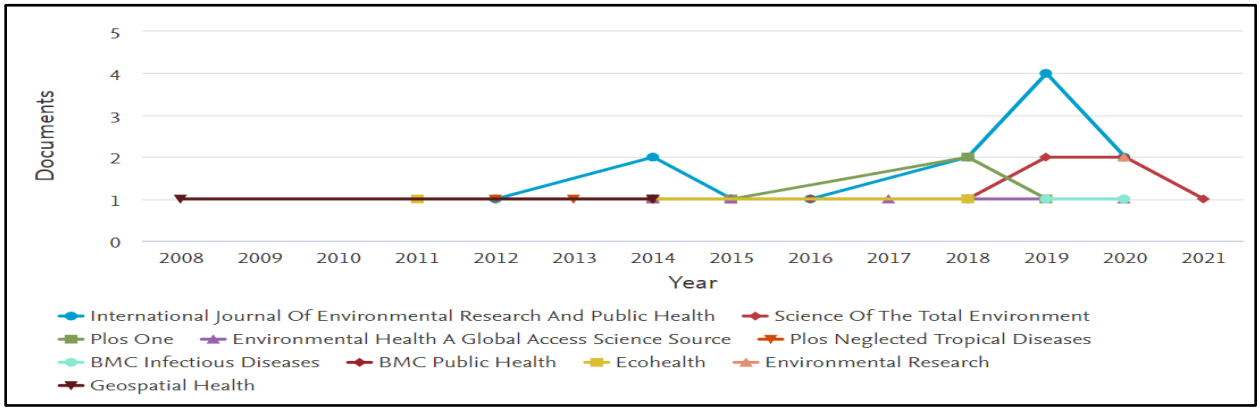

Figure 12: Source Statistics

Source: http://www.scopus.com (Retrieved on 6th December 2020)

## 4. RESEARCH IMPLICATION OF THE STUDY

Climate Change and its effects is one of the most concerning topics in the 21st Century. It has its effects on Agriculture, Health, Lifestyle, etc. The research on climate change is going on world-wide and is ever growing. This research paper is written to index the progress on the topic of Effects of Climate Change on Human health.

From the contents of the table 5 and figure 8, it is clear that there's a massive research gap relevant to this topic in the context of Computer Science and Engineering.

It is also observed that out of 213 total publications, only 13 publications are review papers. This paper hopes to bridge the gap and encourage more researchers to work in this field and use various Machine Learning models to predict future outbreaks and take preventive measures against them.

## 5. LIMITATIONS OF THIS STUDY

The paper only surveys the Scopus Directory by utilizing different keywords for research and audit purposes. Due to this some other important publications and articles could have been missed and weren't incorporated in our study.

## 6. CONCLUSIONS

The direct and indirect effects of Climate Change have a severe impact on Human health. The severity of the health effects depend on many different factors such as Geographical locations, Economic conditions, and vulnerability status of the population. Constant monitoring of climate conditions in countries such as India, which has a vast spectrum of climatic conditions is a necessary step. There is a need to create an efficient Surveillance system which can provide an early warning of climate change so that necessary preventive measures can be taken and outbreaks can be avoided.

This Bibliometric Survey on "Effects of Climate Change on Infectious Diseases" showed that maximum publications are articles. These publications are from conferences and journals related to Environmental Science. The United States leads these publications followed by

Australia and China. Medicine and Environmental Science are the most contributing subjects to the topic.

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