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The influence of industrial clustering on climate change: an overview

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Abstract: Climate change often referred to as global warming is one of the most important issues of the century, and is caused by many factors especially the activities emanating from industrial cluster. The paper therefore, underscores the influence of clustering on climate change. The paper adopts secondary sources of data; and has found out that despite the tremendous benefits of clustering in regional development, especially economic revamping, rejuvenation, overhauling and sustenance, it is not without some negative consequences. One of the major consequences is industrial pollution which has greatly increased atmospheric concentration of water vapour, methane, carbon-dioxide and nitrous oxide, all greenhouse gases which has significantly contributed to climate change. The paper further revealed the various consequences of global warming such as, large scale water and food shortages which can lead to catastrophic effects on wild life. Other consequence includes hurricane, droughts, heat waves and wild fire, changing ecosystem and acidifying ocean and other natural disaster. The paper has found out that, though clustering policy could be harnessed to launch a region into the desired goal of rapid industrialization; the negative impacts especially the emission of gases should be adequately curtailed by government through enacting environmental laws and regulations that promote sustainable industrial development. This could be achieved through the enforcement of pollution laws and control of the energy consumption of these industries. Nations should come together in order to provide solution to the problem of global warming.

Keywords: climate change, clustering, energy consumption, industrial pollution, sustainable industrial development
JEL codes: I15

1. Introduction

Regional clusters may be used as a catch-word for older concepts like industrial district specialized industrial agglomerations and local production systems. A regional cluster may be defined as a geographically bounded concentration of interdependent firms. Locating a firm in close proximity to similar types of firms or suppliers/demanders may have economic motivations

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in terms of enhanced productivity or reduced costs. The implied agglomeration, externalities or economies across firms in an industry or sector may be due to various forces, including a conglomeration of specialized inputs and informational or knowledge spillovers. Externalities are costs and benefits of transactions that are not reflected in prices. Pollution is the most commonly used example of a negative externality. Scitovsky (1954) first developed a conceptual framework to distinguish two different types of externalities according to how they are mediated. First technological externalities arise from non-market interactions among firms in proximity and affect the production sets of firms. Shared knowledge and expertise are the most common sources of externalities. In contrast, pecuniary externalities are purely based on market interactions. Therefore, this type of externalities influences firms only in so far as they are involved in activities that affect price mechanism (O'Flaherty, 2007).

Despite all the advantages that are enjoyed as a result of industrial cluster, it also has negative effects. Clustering cause overcrowding, pollution, high cost of land and traffic congestion, Vibration, irritating fumes, increase in house rent, crime rate increase. Of all these impacts of industrial cluster the most significant contributor to climate change is air pollution. Climate change may be referred to a change in average weather conditions, or in the time variation of weather around longer- term average conditions (i.e. more or fewer extreme weather events). Causes of climate change can be divided into two categories; natural and human causes. The human induced climate changes are caused as a result of certain human activities such as deforestation, agricultural and industrial activities. The emission of gases generated due to clustering have greatly increased atmospheric concentrations of water vapour, carbon dioxide, methane and nitrous oxide, all greenhouse gases that help trap heat near earth's surface. These gases persist in the atmosphere for years, signifying that if such emission were eliminated today, it would not immediately stop global warming. Activities in the industrial cluster is dependent on fossil fuels to spur production and growth, energy is germane in extracting resources from the earth and turning them into goods for consumption.

Cluster policy have been imbibed in the advanced world and has contributed tremendously to their economic advancement, also there has been significant cluster development in the African countries such as Nigeria, Kenya and Ghana. The clustering activities have contributed a great menace to the environment, especially climate change. Climate change is often referred to as global warming, which can also be termed to be an increase in the earth's

average temperature that causes corresponding changes in climate and that may result from the greenhouse effect. The consequences of the global warming could lead to large scale food and water shortages, having catastrophic effects on wild life. It must be noted that the environment is a system; whatever happens in a region may have a rip off effect on the other region, the issue of climate change therefore calls for a global concern. In the light of this, the paper seeks to examine the influence of clustering on climate change.

2. Conceptual issues and literature review

Climate is defined as an area's long-term weather patterns. The simplest way to describe climate is to look at average temperature and precipitation over time. Climate change, therefore, is a change in the typical or average weather of a region or city, NASA Goddard, 2012. Gavin Schmidt (2011) asserted that this decade is warmer than the last decade and that decade was warmer than the decade before. The planet is warming. The reason it's warming is because we are pumping increasing amounts of carbon dioxide into the atmosphere." In its 2007 report to the United Nations, the Intergovernmental Panel on Climate Change (IPCC) concluded that it is more than 90 percent likely that the accelerated warming of the past 50-60 years is due to human contributions.

A substantial body of literature has emerged on the theory of the geographical clustering of firms and a large number of empirical studies have attempted to identify and assess the role of clustering of economic activity in relation to innovation and economic performance. Though there are lots of advantages that are enjoyed as a result of clustering economies, it also has negative effects. Despite the difficulties in quantifying the costs to health or property arising from air pollution impacts generated by different distributions of industry relative to the surrounding population, there is evidence that general planning strategies for the location of industry have been formulated in several countries upon the basis of intuitive judgments regarding the balance of social costs and benefits arising from further development in existing clustering as compared with policies of dispersal (Porter, 1990, 1998a, 1998b). Physical planning policies which incorporate such judgments have been introduced in the Netherlands, Scotland and Sweden. Although such policies are usually concerned with the distribution of population and economic activity in general, there is also evidence of an awareness of the potentially undesirable social and

environmental consequences of the uncontrolled growth of agglomeration of specific types of manufacturing industry. In his contribution Dasgputa and Wheelers (2008) calculated the particulate emissions in metric tons per employee by firm size in Brazil and discovered that industrial cluster contribute a non-negligible share of total pollution loads. However, on the aggregate they discovered that clustering firms accounts for 62% of industrial pollution in Brazil. This according to him provides evidence for the national policy in regulating clustering industries.

Industrial cluster has generated a surge of interest among environmentalist and planners who are interested in the environmental impacts of clustering. In recent years, scholars such as Wheeler (2004) have tried to analyze the correlation between environmental damage, especially climate change and the growth of firms particularly in developing countries where the growth has been phenomenal. The environmental impacts of firms in the developing world have tended to be ignored, although the promotion of such enterprises is seen as a way to provide employment and incomes, there is little evidence available on environmental impact and sustainability. There is indeed the general assumption that because they are development facilitators, these industries have little impacts.

3. The scale and benefits of clustering economies amongst firms

The success of some regional clusters has focused attention on the creation of external economics and on the role of knowledge intensive, local environments in stimulating the competitiveness of network of firms. Competition is increasingly seen to occur between clusters, value chains or network of firms rather than just between individual firms. The economies of scale that are enjoyed by the manufacturing establishments in the metropolitan areas accounts for the concentration of these industries in the city. These economies of scale are both internal and external. The internal economies enjoyed by the firms that are concentrated in an area may include managerial economies, which are likely to be those derived from specialization. That a firm locates in the midst of other manufacturing firms, allows it to employ specialist each of whom by devoting all his attention to a relatively small part of the company's work, may do much to increase productivity. Collaboration in research and development also help the firms that agglomerate especially in the design and development of new products, which may seem to be a

protracted and expensive undertaking by a single firm. Also, the provision of specialist maintenance services or training facilities or the development of a pool of labour with the skills appropriate to the industry has been made possible by the agglomeration of firms over space. External economies are also realized through a trade association.

No doubt, business firms find it profitable to cluster together spatially with firms in their own and other industries. The metropolitan area contains not only a large number of different industries, but also has a final product market (because the threshold requirement is obtained in the city), a labour pool, good communication and a variety of specialized services. The concentration of industries with functional linkages in industrial agglomerations as earlier stated brings about financial savings on the part of the industries concerned. Such savings are achieved because agglomerated firms can and do share common services such as water, communication facilities, security, transport facilities, communication facilities, diffusion of know-how, research and rapid circulation of capital commodities and labour. Individual industries are thus saved from the cost of providing these services for themselves. Such financial savings are referred to as external economies of scale. Agglomeration also has the advantage of concentrating labour, managerial skill, capital and customers in specific places, thereby making such places still more attractive to industries. This is one reason why agglomeration tends to grow once they come into being. A new industry attracts related industries as well as social services which in turn make the area more attractive for more industries in a chain reaction referred to as the multiplier effect.

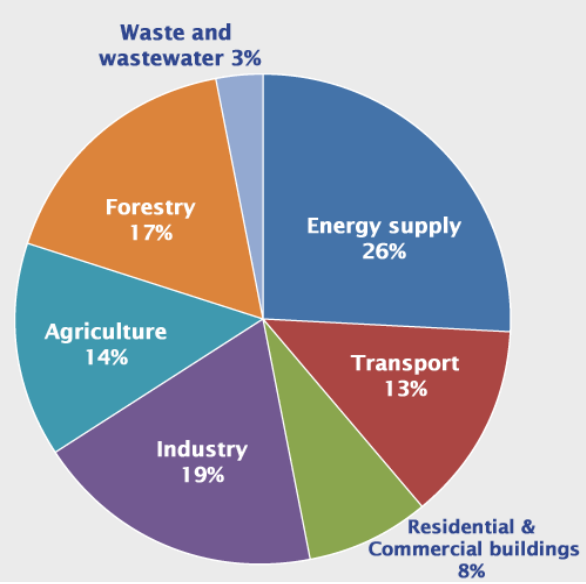
4. Clustering and its influence on climate change

The negative impacts of clustering on the environment ranges from; Land pollution, heavy traffics, vibration, air pollution, water pollution, irritating fumes, to noise pollution. This paper however, posits that climate change may be understood from clustering perspective. The industrial revolution in the 19th century saw the large-scale use of fossil fuels for clustering activities; fossil fuels such as oil, coal, and natural gas in power plants, automobiles, industrial facilities are employed. Because of its dependence on fossil fuels to spur production and growth industrialization has radically changed the global environment. The air pollution generated as a result of clustering activities have tremendously increased atmospheric concentrations of water vapour, carbon-dioxide, methane, and nitrous oxide, all green gases that significantly contributed

to climate change. The result of these gases that are emitted has led to increase in the earth's average temperature that causes corresponding changes in climate; this is often referred to as global warming.

The atmosphere is made up of gases and vapour, and receives incoming solar energy from the sun giving rise to what we call climate. When sunlight reaches earth's surface, it can either be reflected back into space or absorbed by earth. Once absorbed, the planet releases some of the energy back into the atmosphere as heat (also called infrared radiation). The climatic elements such as temperature, precipitation, clouds, pressure and humidity within the troposphere account for the great variations in local climate and weather that play such a great part in our daily lives. Since preindustrial time's atmospheric concentrations of CO_2, CH4 and N_20 have climbed by over 31 percent, 151 percent, and 17 percent, respectively. Figure 1 shows the contribution of the various sector of the economy to gas emissions globally; Gas emissions from the industrial sector constitute 19%, agriculture 14%, forestry 17%, waste and waste water 3%, Energy supply 26%, transport 13%, Residential and commercial buildings 8%. This has lent credence to the significant contribution to the climate change as a result of industrialization of which industrial cluster remain a potent factor.

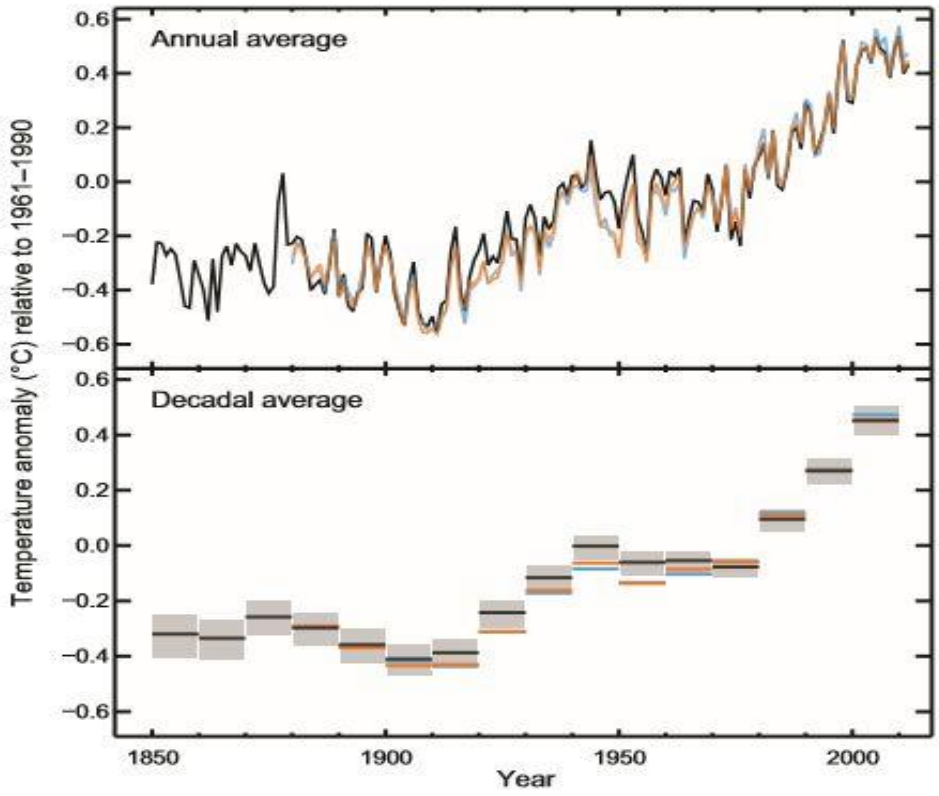
Figure 1. Sectoral gas emission globally



Source: IPCC, 2007.

Figure 2 shows the observed global mean combined land and ocean surface temperature anomalies, from 1850 to 2012. The annual average temperature and the decadal average temperature have been on the increase, this is another assertion that the earth is warming as a result of the increase in temperature.

Figure 2. Observed globally averaged combined land and ocean surface temperature anomaly 1850–2012

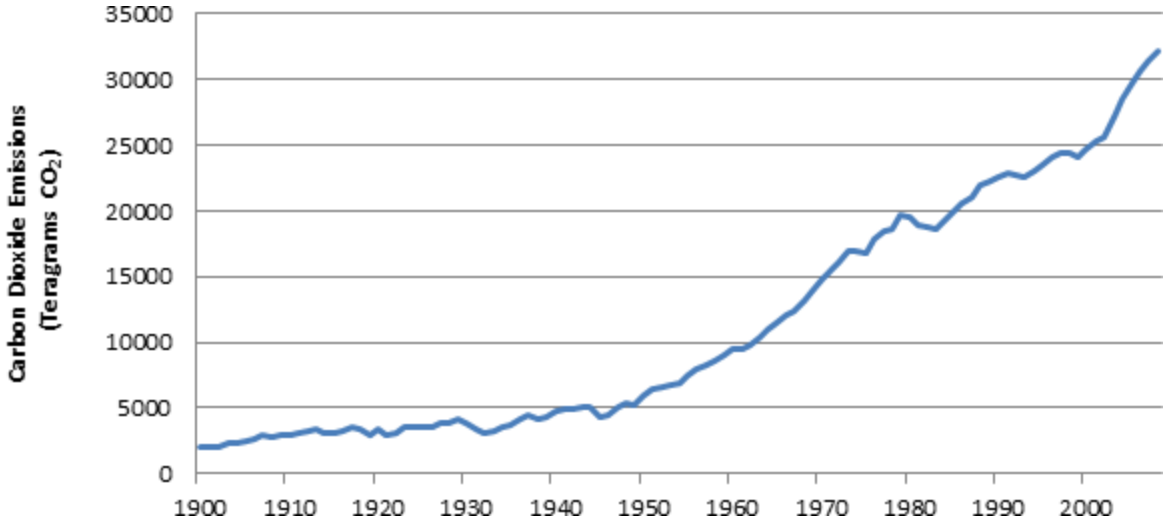


Source: IPCC, 2013.

5. Trends in global carbon dioxide (CO2) emissions from fossil-fuels 1900-2008

Figure 3 depicts the trends in global emission of gases. It is obvious that emission of gases has been on steady increase from 1900 which is the period that marks the industrial revolution. Apparently the graph rose sharply in 1950 which connotes that civilization and industrialization has significant positive relationship. More industries give rise to a proponent increase in the gases emission; this also signifies that increase in the gases emission has been unabated

Figure 3. Global, regional, and national fossil-fuel CO_2 emissions



Source: Boden, T.A. et al., 2010.

8. The Consequences of Climate change ‘’Global warming’’

It is apparent that climate is warming, there have been many indications especially since 1950s, and the atmosphere and ocean have shown substantial evidences of warming. These have culminated to wide raging impacts, such as drought, extreme rainfall, the reduction in the amount of snow and ice, while sea level and the concentrations of greenhouse gases have risen. Posing significant risks to human health, our forests, agriculture, freshwater supplies, coastlines, and other natural resources that are vital to economy, environment, and our way of life. Even seemingly less dramatic local changes in temperature, precipitation and soil moisture could severely impact many things important to human life and all life around us, including: agriculture and food supplies, human health, natural ecosystems, forestry, water resources and availability, energy use, infrastructure and transportation.

Another problem associated with climate change is the ozone depletion. The ozone layer is very important because it stops too many of the sun's 'ultra-violet rays' (UV rays) getting through to the Earth - these are the rays that cause our skin to tan. Too much UV can cause skin cancer and will also harm all plants and animals. Life on Earth could not exist without the protective shield of the ozone layer. One group of gases is particularly likely to damage the ozone

layer. These gases are called CFCs, Chloro-Fluoro-Carbons, which are powerful infrared absorbers. Chloro-Fluoro-Carbons releases have declined since many of their uses were banned, but the CFC's already in the atmosphere will persist for many years. Global warming could lead to Hurricanes, heat waves, wild fires and other natural disaster, changing ecosystem and acidifying ocean due to higher levels of CO_2 being absorbed are consequences of climate change. Also, it may lead to ice melting in the Antarctic and Greenland region; the melted ice will flow into sea. People living in the coastal areas may have to move inland due to increase level of water, therefore leading to population explosion in the inland, this will be followed with lots of consequences. Droughts are becoming more frequent and widespread. In Africa, for example, droughts have increased about 30 percent since 1970. Drought was the single largest cause of water and food shortages. Biologists report that many animals are breeding earlier or extending their range into new territory as the climate changes.

8. Conclusion and recommendation

Over the last century the average global temperature has climbed about 0.60C (10F). Nineteen of the 20 warmest years in the past 150 have occurred since 1980. Since the Industrial Revolution began around 1750, human activities have contributed substantially to climate change by adding CO2 and other heat-trapping gases to the atmosphere. Global carbon emissions from fossil fuels have significantly increased since 1900. Emissions increased by over 16 times between 1900 and 2008 and by about 1.5 times between 1990 and 2008. The issue of climate change is a concern for all and sundry because so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risk. This paper has reveals the significance of clustering to regional development, the economies generated are economic booster which serves as catalyst for regional development. Though there are other sources such as agriculture, transport, agriculture, forestry, waste and waste water, energy supply , Residential and commercial buildings ;the paper has shown a significant contribution to climate change as a result of clustering activities. Many industrial processes emit CO2 through fossil fuel combustion; several processes also produce CO2 emissions through chemical reactions that do not involve combustion. It is also vivid from the research that carbon-dioxide is the most significant emitted

gases. The global trends of gas emission indicate a steady increase in gas emission over- time, though there was a sharp rise in 1950. The research further revealed that China and United States of America are the leading emitters of gases. This is because these two nations are heavily industrialized, which connotes that more energy are consumed due to industrial activities.

Climate change and its effects appear to be accelerating faster than scientists had predicted and the main human activity that emits CO2 is the combustion of fossil fuels (coal, natural gas, and oil). The most effective way to reduce carbon dioxide (CO2) emissions is to reduce fossil fuel consumption, to avoid worsening climate impacts and reduce the risk of creating changes beyond our ability to respond and adapt. The paper has found out that, though clustering policy could be harnessed to launch a region into the desired goal of rapid industrialization; the negative impacts especially the emission of gases should be adequately curtailed by government through enacting environmental laws and regulations that promote sustainable industrial development. This could be achieved through the enforcement of pollution laws and control of the energy consumption of these industries. Nations should come together in order to provide solution to the problem of global warming. Producing more energy from renewable sources and using fuels with lower carbon contents are ways to reduce carbon emissions. Individuals can help reduce global warming through, planting of trees, insulation of houses and seal all drafts and production of less waste. Although some actions may cause only a small impact, collectively they add up.

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Wpływ klastrów przemysłowych na zmiany klimatyczne: przegląd

Streszczenie

Zmiany klimatyczne, często odnoszone do globalnego ocieplenia, stanowią jeden z najważniejszych problemów obecnego stulecia. Spowodowane są one przez wiele czynników, w tym zwłaszcza przez działalność przemysłową. Artykuł podkreśla wpływ klastrów na zmiany klimatyczne, posługując się pośrednimi źródłami danych i wskazując, iż poza niezwykłymi korzyściami klastrów przemysłowych dla rozwoju regionalnego, głównie naprawą, odnową i przebudową gospodarczą, występują też pewne negatywne konsekwencje. Jedną z głównych konsekwencji jest zanieczyszczenie z przemysłu, wskutek którego wzrasta koncentracja w atmosferze pary wodnej, metanu, dwutlenku węgla i podtlenku azotu, wszystkich gazów cieplarnianych znacząco przyczyniających się do zmian klimatycznych. W dalszej kolejności w tekście przedstawiono różnorodne konsekwencje globalnego ocieplenia, takie jak podnoszenie się poziomu wody, niedobory żywności, co może oznaczać katastrofalne skutki dla dzikiego życia. Inne efekty obejmują susze i huragany, fale gorąca i niekontrolowane wybuchy pożarów, zmiany ekosystemów, zakwaszanie oceanów i całą gamę innych katastrof naturalnych. W artykule stwierdzono, że o ile polika rozwoju klastrów może być nastawiona na wprowadzenie regionów w osiąganie pożądanego celu uprzemysławiania, o tyle negatywne efekty tych procesów, zwłaszcza w postaci emisji gazów cieplarnianych powinny być odpowiednio zredukowane przez rządy poprzez uchwalanie praw i regulacji środowiskowych promujących zrównoważony rozwój przemysłu. Może to zostać osiągnięte poprzez wzmacnianie prawa dotyczącego emisji zanieczyszczeń oraz kontrolę zużycie energii przez przemysł. Narody powinny współpracować ze sobą w celu rozwiązania problemu globalnego ocieplenia.

Słowa kluczowe: zmiany klimatyczne, klastry, konsumpcja energii, zanieczyszczenia z przemysłu, zrównoważony rozwój przemysłu