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What are the hidden global food crises that challenge future development?

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Abstract

The aim of this article is to focus on world economic prospects, especially the risk and opportunities facing the world food supply due to climate changes. The brightening and dimming phenomena require more awareness on global scale. Negligence of such problems will intensify future challenges reflected in water scarcity, decline in the cultivated arable lands, and the increase in number of refugees. Despite these challenges, adopting risk macroeconomic and environmental policies to face the upcoming economic risks is highly needed. Inattention of such problems will intensify future challenges and devastate development. The study proposes the required policies to adopt effective macroeconomic and environmental policies to face the challenging future development objectives.

Keywords: Food risk and opportunities; Dimming; Brightening phenomena; Development challenges

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1. Introduction

On February 2008, the journal Science published forecasts of Stanford University, California, which foresee that South Africa could lose more than 30% of its maize production from 2000 to 2030. Moreover, the (FAO) Food and Agriculture Organization in 2010 recorded that the number of people suffering from hunger is around 925 million, which represents 13.5% of the world population. Sasson (2010) provided a comparison for the people suffering from hunger showing that around 578 million in the Asia Pacific region; 239 million in sub-Saharan Africa; 53 million in Latin America and the Caribbean; 37 million in North Africa; and 19 million in developed countries.

This article's aims at relating the irregularity in atmospheric temperature, precipitation and global radiation reaching the earth surface which presents a real challenge to all mankind with the upcoming world economic risks and opportunities. From these challenges the dimming phenomena that results from air pollution and thicker clouds, a challenge that exists and will continue to remain uncertain in the near future. The consequences of dimming don't lie on its intrinsic importance to the environmental issues but also to the economic dilemma it creates.

This is not intended to be an empirically grounded article, but empirical examples are provided wherever they are needed to strengthen the arguments. The article is structured into four sections. The second section is devoted to the literature review of both phenomena. The third section focuses on the dimming effects, while section four, includes an answer on how to mitigate the climate change impacts on the agricultural sector, section fife sets the analysis of adaptation into institutional and policy driver contexts. Finally, the last section summaries the main points drawn up from this article are summarized.

2. Literature review

The Swedish Nobel chemist, Svante Arrhenius (1896), proposed that doubling of the atmospheric carbon dioxide (CO_2) concentration (due to human activities) would lead to a 5°C increase in the earth's surface temperature. After World War II, scientists had a good chance to investigate the effect of various types of smokes, poisonous gases, and nuclear fallout. A great interest was directed towards studying the effect of greenhouse gases on radiation transmitted to the atmosphere. The green house effect was a term used to describe warming of earth due to excessive production of greenhouse gases mainly CO_2, nitrous oxide (NO_2), methane, and chlorofluorocarbons (CFC). These gases absorb radiation travelling to space, and re-emit the ensuing energy to the lower levels of the atmosphere.

Scientists in the mid of 21st century, focused on how the microscopic particles could travel further. Using networks of monitoring stations to measure atmospheric changes, McCormick, R.A., & Ludwig, J. H. from U.S. National Center of Air Pollution reported a rise in turbidity over regions spanning as much as 600 miles (McCormick et al., 1967). It seemed that both industrial pollution and haze could have a global reach. Furthermore, Mitchell J.M. recorded that this tendency could contribute to cooling of the earth's surface

through reflection of the sunlight back to the upper atmosphere without reaching the surface (Mitchell, 1970).

Later, a study by Bolin and Charlson collected data for air purity and in this study; they showed that sulfate aerosols seriously affect wide regions (Bolin, 1967). These measurably dimmed the sunlight, not only in cities but also across the eastern United States and Western Europe. Sulfates were a new worry for the scientists who were concerned about future climates. Since the mid 1970s, many studies had proven that such aerosols could significantly dim sunlight for thousands of kilometers downwind from the factories. Moreover, Mitchell recorded a decrease in the radiation reaching the earth surface owing to reflection of sunlight back to the upper atmosphere (Mitchell, 1970). These studies reasoned dimming problem to aerosols which intercept sunlight and affect climate by creating clouds.

There was an essential distinction between dimming by scattering aerosols like sulfate, and aerosols forming soot. For sulfate, the dimming at the surface was nearly the same as the net radiation force and this was due to sulfate aerosol in the top of atmosphere, since there was no compensatory heating of atmosphere. Therefore, a direct comparison of the surface dimming with greenhouse gases is appropriate. With respect to soot, the dimming at the surface is mostly due to increase in atmospheric solar absorption; hence the dimming does not necessarily reflect a cooling effect. In particular, aerosols are condensed particles in sub micron size; they represent one of the major components of the earth atmosphere, and are released to the atmosphere by burning of fossil fuels and volcanoes. As fuels burn and convert to energy, these emitted numbers of pollutants are capable of changing their properties in the cloud.

The effect of sulfates was confirmed by different studies carried after the Mexican volcano *El Chichón* in 1982. These studies present the direct effect of volcanic aerosols and it's participating in pollution. In 1989, Ohmura et al. recorded the changes in the surface of solar radiation over Europe and proposed that there was a 10 % drop in the level of solar radiation over three decades (Ohmura et al., 1989). It is noteworthy that aerosol plays a key role with respect to the solar radiation reaching the ground to shape the type of climate change on Earth. Later, in Philippines, the eruption of Mount "Pinatubo" present an evidence of a powerful eruption providing a 15 to 20 megaton release of SO_2 into the stratosphere. This eruption produces a sufficient aerosol to counteract the global warming trends, (Christy et al., 1994). This eruption increased the diffuse of radiation later owing to the release of huge sulfate aerosols into the stratosphere.

Furthermore, other studies have shown a similar interpretation of the dimming problem. For example, Stanhill performed a long term study to monitor the level of sunlight reaching the ground during 1950 and 2000 and estimated that sunlight decreased by 2.7 % per decade, a 13% over the entire period. This unpleasant phenomenon geared Stanhill to conduct more research to confirm his results. He recorded the changes in sunlight radiation from all over the world and concluded that this phenomenon exists in several countries where the sunlight gets dim by approximately 10 % in the United States, 30 % in some areas of the former Soviet Union, and almost 16 % drop at the British Isles (Stanhill, 1990). However, these results were ignored. A similar study presented by Thomas, was based on records from 60 climate stations during the period 1954–93, and he reported the reduction in the potential evaporation over China due to the heavy air pollution (Thomas, 2000). Remarkable consumption of fossil fuels was suggested as one of the major reasons

for global dimming. Also, casual incidents, such as volcanic eruption, can also result in intermittent global dimming. Specifically, the decrease in surface solar radiation between the 1950s and 1980s, was popularly known as ‘‘global dimming’’ (Stanhill, 1990).

Supporting the existing of global dimming, in the light of the global warming was hard to be explained, until Roderick et al. (2002) were able to correlated global dimming with the decrease in the rate of water evaporation. They showed that the temperature was not the only important factor in the evaporation and the rate was dropping due to less radiation from the sun shining on the water surface, which was a strong proof of global dimming. Thus, the global pan evaporation data independently confirmed the dimming data. Moreover, they examine the pan evaporation trends in the Northern Hemisphere, and more recently in the southern hemisphere mainly at Australian National University in Canberra, and they confirmed a worldwide decrease in pan evaporation. However, since 1990, this trend at the global scale was reversed and “global brightening” was measured at a rate average of 0.10% per year (Pinker et al., 2005; Wild et al., 2005; Norris and Wild, 2007). Thus, the aerosol is the core factor behind dimming the sunlight in certain regions (Ramanathan et al., 2001; Kaufman et al., 2006; and Rosenfeld, 2006). Through studying multi-year trends, it is proposed that the total radiation reaching the earth’s surface can change over periods of 20-50 years. The declines in atmospheric transparency have been linked to volcanic activity and it is documented by Roderick et al. (2001) and Lohmann et al. (2006).

On the other side, the decrease in cloud is associated with global warming (Nazarenko and Menon, 2005) and improved air quality (Norris and Wild, 2007). In Europe and the United States, brightening persists to some extent there, while it witnesses a tremendous increase in emission since 2000, in China, as well as unabated dimming in India (Wild, 2009).

In 2008, United Nations Environmental Program (UNEP) reported, that there are many cities becoming dimmer over time precisely in Asian cities, Beijing and New Delhi. In China and Western Pacific Ocean, there is a three kilometer-thick layer of atmospheric soot. It is a result of burning fossil fuels and biomass that form Atmospheric Brown Clouds (ABCs). Therefore, the major source of dimming is ABC absorption of direct solar radiation. This direct absorption and reflection of solar radiation was done by aerosols, in addition to emissions of black carbon and sulfur (gaseous precursor of sulfate). This black carbon has a core role in climate change because of its short life time as it doesn’t affect air quality only but also agriculture (Ramanathan, 2008).

A study of the surface solar radiation in Northwestern Europe and the European Arctic reported that the level of sunlight has significantly decreased from 1950s to 1980s followed by a slight increase in recent years (Stern et al., 2009). Researchers think that these substantial decadal changes in surface solar radiation have major impacts on various aspects of the climate system; such as global warming, the intensity of the hydrological cycle, glacier and snow cover changes (Wild M., 2009, 2013). Mainly in all models, aerosols were prescribed as atmospheric burdens rather than interactively measured from prescribed emissions, which allow for more degrees of freedom. Also, most of the models consider sulfate aerosol only and do not include additional aerosol types, such as black carbon (Wild and Edgar, 2010).

In Northeastern Brazil, a recent study provided consistent evidence of the global dimming effect. Researchers recorded a decrease in solar radiation in a large area which is statistically significant, supporting the alterations in solar radiation and sunshine duration due to the changes in atmospheric optical properties (Vincent et al., 2010). Recently in 2012, Wild states that developing and emerging nations will witness an increase in air pollution and associated renewed dimming. The researchers of the dimming and warming phenomenon could not reach to a precise conclusion which one of these phenomena will dominate. Most likely, dimming will represent a future threat to human welfare and environment unless intervention policies are implemented. Yet questions still need answers, what are the dimming double-edged effects (pros and cons)? What are their impacts on food supply?

3. Dimming the invisible phenomenon

The global dimming phenomenon was not recognized enough with its significant impact that varies in time and location. Dimming has a local effect because aerosols have a short lifetime (that last for a week), in contrast with greenhouse gases - which have a lifetime up to 100 years. It is worth to mention that the measurement of environmental phenomenon was based on a station trying to measure the effects of aerosols and these results are highly affected by the level of technology used. On the other hand, the global dimming has a significant impact depending on the consumption of fossil fuels levels in each country. Dimming presents a new challenge to mankind which will have a socio – economic, social and environmental consequences on the globe. The next section will discuss the negative effects of dimming.

3.1. Dimming negative effects

Dimming phenomenon has serious multiple effects on the environment; such as human health and food supply. In 2005, FAO reported that 30 % of the world cereal stock levels decrease annually by 30% (FAO, 2005). In the case of crop loss in the northern hemisphere, these losses are not compensated with imports from the southern hemisphere or vice versa. The change to frost/cold-resistant crops might be fairly easy in some countries, such as growing hardy potatoes or beets instead of cereal grain, or growing wheat instead of maize. In some developing countries, hardy alternative crops have been known for centuries, such as grass, pea in Bangladesh, India, China, Cassava tubers in Africa and South America.

In the case of South Asia, there was evidence that climate change was already underway, and had significant negative impacts on agriculture. Climate change in the region was obviously due to the combination of the effects of greenhouse gases and Atmospheric Brown Cloud (ABCs). Auffhammer et al. (2006) show that regional climate change significantly reduced the harvest of rice in India during 1966-98, and ABC had a direct and indirect impact on farming.

Recent study was carried out to estimate the changes of irrigation water demand in dry-season *Boro* rice fields in Northwest Bangladesh -in the context of global climate change- showed that the climate change will increase the daily use of water for irrigation by the end of this century. As underground water is the main

source of irrigation in *Boro* rice field in North-western Bangladesh, higher absorption rate of groundwater may cause negative impacts on groundwater resources in the region. Thus, the declining groundwater level may cause an increase of irrigation cost in the area and the economic losses of farmers (Shahid, 2010). Furthermore, shortage of ground water will force people to migrate to other places, and this will affect global demographic distribution. All this will create more pressure on the developing countries; taking into consideration the pressure generated by population growth.

Scientists also believe that a major effect of dimming was the shielding of sunlight power over the ocean which disturbs the pattern of rain. Ramanathan et al. (2005) conducted a coupled ocean atmosphere model study with climate change affects agriculture and food production directly through changing agro-ecological conditions and indirectly by affecting growth and distribution of incomes, and thus demand for agricultural products. In 2008, Ramanathan thought that the global dimming may have an unfavorable impact on the Asian monsoon. He reasoned that such a phenomenon was the main cause behind the drought occurred in Sub-Saharan Africa between the 70s and 80s killed human.

Numerous climate model studies suggested that taking aerosols as a factor for dimming can clarify the Sahel drought refereeing to tropical rainfall trends and the indirect aerosol effect, in addition, to the decrease in Indian monsoon rainfall (Rotstayn and Lohmann, 2002; Ramanathan et al., 2005). However, to document the relation between dimming and the changes that exist over oceans, it requires long term observation stations over oceans. Satellite-derived observations suggest a brightening over the oceans since satellites became operational in the early 1980s.

Dimming phenomenon can cause ecological problems such as changes in evaporation, rainfall patterns and consequently impede the agriculture sector. As previously discussed, it is important to envisage the effect of this phenomenon on our economy. If it is100% confirmed and becomes scientifically proven, we will amplify a problem that already exists in parallel with other challenges like the decrease in the water resources and cultivated areas that will not meet the current increasing population demand. In case of the potential decline in these sources, especially crops and water, the next years will witness new economic dilemmas.

3.2. Dimming positive effects

On the other side, global dimming phenomenon is a huge issue of debate among scientists between opposing and approving. Scientists argued that the records lacked accuracy due to deficient technology in the used instruments. Solar radiation was measured by observing how far the side of a black plate warms up when exposed to the sun, compared to the shaded flip side. From 1930 to 2002, Ramanathan et al. (2005) found that in India aerosols may have masked as much as 50 % of the surface and the Atmospheric Brown Cloud (ABC) was masking the GHGs warming in the Northern Indian Ocean (NIO), such that the NIO was not warming as much as the southern Indian Ocean in response to the GHGs warming. Moreover, the “dimming” trend was reversed, particularly over Europe; this was due to decrease in pollution. As many governments in the developed nations implemented constraints to reduce aerosols released into the atmosphere which

consequently helped to stop global dimming but didn't reduce CO_2 emissions (Wild et al., 2005; Pinker et al., 2005) (see Figure 1 in the Appendix).

In 2008, Allen et al. found that the twentieth century greenhouse effect was in the range of 0.3 –1.2◦C, with a cooling of 0.7 ◦C due to aerosols. Later, researchers showed that while surface solar radiation was going down, global temperatures were rising. This was due to their observation of an increase in temperature, as they observed only the sum of the greenhouse and radiation effect, but not separated. Moreover, researcher provided evidence for the role displayed by the radiation effect in masking 58% of the increase in global warming due to the greenhouse gases (Zheng et al., 2010). In conclusion, the radiation effect offset the green house effect. From the previous review, several studies provided evidence for the role of air pollution in masking global warming, and how air pollution would mitigate the effect of the climate warming trends in the coming decades.

3.3. The relation between aerosols, dimming and its effects

The aerosol effects on crops rely on the factors that result from industries and vehicles exhaust and as water vapour or dust in the air. These effects vary from short to long distances. In the following section a discussion of the direct and indirect effects of aerosols will unfold.

3.3.1. The direct effects of dimming

The direct effects of dimming are caused by the radiation absorption of the carbonaceous and silicate aerosols. In this regard, it is important to test the impact of the aerosol distribution on other climatic parameters, particularly temperature, which is one of the driving forces in the seasonal circulation over the subcontinent. Climatic processes are a result of the differential heating of land and sea leading to a seasonal reversal of regional wind flows (Webster, 1987). To examine the impact of carbonaceous aerosols on surface climate, researchers reported that there is a significant cooling for the surface temperatures, that enhanced precipitation, and runoff caused by atmospheric absorption of sunlight leading to thermally driven circulations that favor transport of moisture from adjacent oceans (Roeckener et al., 2006). Moreover, Verma et al. (2006) documented the transfer of aerosols from source regions over the subcontinent to adjacent marine environments during the northeast monsoon season.

Recent studies indicated a positive forcing of aerosols due to increased night-time temperatures associated with greater cloud cover. This leads to a rise in night-time temperature, giving way to a decline in diurnal temperature range (DTR) especially over the western part of the Gangetic basin during the summer monsoon season with a simultaneous increase in cloudiness (Huang et al., 2006; Sen R. and Balling, 2005). Add to this, dimming was found by the mid 1980s, and brightening starts to dominate also the DTR decline was no longer seen (Wild et al., 2007). To assess the implications of regional diverse impact of climate change and show the effect of climate changes on crops of countries, Huey-Lin Lee (2009) showed that countries that are located in higher latitudes, their crops benefit from these changes. In contrast, countries of the lower latitudes suffer from the reduction in crop yield being induced by climate change. The aerosol direct effects on crops rely on the aerosol optical depth (AOD), which may protect crops from low night-time temperature

and frost damage. In case of scattering particles, the amount of sunlight that reaches the earth's surface is reduced due to the presence of the aerosol, which is likely to be protective in this way. However, frost protection is a benefit that needs to be investigated.

3.3.2. The indirect effects of dimming

The indirect effects of aerosol particles depend on the cloud microphysical properties, such as reflectivity, lifetime and precipitation rates. It is attributed to the hydrophilic atmospheric aerosols, which is necessary to the water vapour condensation and to the generating of the cloud droplets. Hence, the high concentration of these aerosols increases the droplets number and optical thickness of the cloud that, in turn, intensifies the reflection of solar radiation. From the results of the airborne radiation observations of the last few decades, it has been revealed that direct and indirect effects of the aerosols influence differently depending on the increasing or extinction of the solar radiation absorption in clouds in different origin in different geographical regions (Hobbs 1993; Harries 1996). The use of satellites provides a wider geographic coverage of aerosol impact on surface temperatures that was found to be stronger over the more industrialized and urbanized areas of the subcontinent (Di Girolamo et al., 2004; Huang et al., 2006). Industrialized countries produced polluted aerosols. These tiny particles' behaviour is different depending on its solubility in water and the suspended particles. Consequently, it affects the land productivity depending on the type of water pollutants.

4. An economic perspective on how to mitigate the impact of climate changes?

This section tries to highlight the impact of climate food supply worldwide, and it tries to propose the appropriate approaches to mitigate the effects of the upcoming food supply uncertainties.

4.1. Impact of climate change on food production

Climate change is considered a major threat to agriculture and food production. IPCC, Intergovernmental Panel on Climate Change documented that around 28% of the States farming acres depend on irrigation and warm temperatures. In 2007, IPCC documented that agriculture sector represents two-thirds of agency revenue (especially crops like wheat, barley, hay, and potatoes), were 28% of the States farm acres depending on irrigation than in case of warmer temperatures, wheat yields could increase between 70 - 90 %. While barley and hay fields could decrease by 4-14 %, and potato yields could fall by 17 %. On the other hand, the estimated loss range between $ 465 million to $ 2.4 billion annually in Pacific Northwest agriculture sector as it depends on surface water irrigation (Goodstein, 2004), and the damages for irrigated agriculture and salmon alone would range from 2% to 2.8% of regional gross domestic product (GDP) by 2050.

In the last three decades, droughts and heat waves caused about $145 billion loss across the United States (Lott and Ross, 2006). In 2006 and 2007, food supply witness adverse weather conditions in some major areas producing grain and oilseed such as Australia. Also, the European Union (EU) and Ukraine have been

cited as one of the areas that suffer from a recent decline in food production. The IPCC provide the expected impacts on urban and agricultural areas; it shows the effects on the food sources of urban areas, as a result of global climate change (see Table 1 in the Appendix). The increase of variability in climate change sets more pressure on farmers to adapt, which was very hard to be done from their side only.

The drop in food supply and the estimated increase in food demand are the drivers of food insecurity- which will have adverse socio–economic, social and environmental consequences.

In the 2007, Stern's review identified a variety of potential impacts that are expected to change under a range of emission scenarios in which no more mitigation measures are adopted in the near future. Some of these impacts are likely to be beneficial for humans, but others are expected to be adverse, and in some cases have potentially damaging effects. Many of these impacts reflect on ecological shocks that are characterized with uncertainty. These are highly related to the increase in temperature through time and it differs from region to another.

Later, in 2008, Alpert and Kishcka (2008) showed that the magnitude of dimming was strongly dependent on the population density and they reported that dimming varies per decade for sites with population density. The main reasons of dimming were the emission level, high population density and lack of environmental regulation. These reasons give the dimming problem a significant impact on some countries and not all. Also, regions that are downwind from major sources of air pollution -specifically sulfur dioxide emissions- have generally lower temperature.

Since, people do not live on the globe; they live in regions and communities so they cannot respond to global estimation without awareness of the regional impacts of climate change which effects there sustainability. Moreover, dimming exists mostly in developing countries, which are flooded with many economic and political problems requiring them to focus on their basic needs, thus giving less weight to the pollution problem. However, Dimming was an unavoidable problem as we can't confine its effect to certain region, or a group of countries.

In Africa, the agricultural production and food access is severely compromised due to climate changes and precipitation vulnerability. Consequently, this change in precipitation affected food security and exacerbated malnutrition, particularly in the Sahel region of Africa that witnessed an extensive crop failure. Moreover, by the end of 2011, Somali also witnessed a crop failure and escalating famine problem with the increase of less than 1° C. Stern's report projected that by 2020, between 75 and 250 million of people will suffer from water levels drop, shortage of food production and decrease in the livestock productivity.

UNDP's report documented that arid and semi arid land in Africa suffer from climate changes. While in Asia they estimate that by mid 2050, larger river basin will face a decrease in fresh water availability. In South East Asian coastal area characterized with heavy population will be at greater risk due to the increase of floods from sea and rivers. Consequently, this will decrease agriculture supply, especially the rice yield. In addition, Australia and New Zealand will experience a water security problem by 2020, which will cause a decline in agricultural production due to the increasing pattern of drought and fire. By 2080, the cost of adaptation will increase from 5% to 8 % of Gross Domestic Product (GDP) (UNDP, 2008).

In Europe, UNDP reports estimate that they will witness gains especially in some northern households, as they will face less severe cold temperature. On the other hand, negative impacts will include increased risk of inland flash flood and more frequent coastal flooding. In Southern Europe, especially Mediterranean areas will suffer from high temperature and drought in the regions that are already vulnerable to climate variability. While in Latin America, by the mid of the 21 century, countries will witness higher temperature associated with a decrease in water soil leading to gradual decrease in some crops and declining livestock productivity associated with adverse consequences of food security. Moreover, in North America, the report projected an increase in temperature, precipitation and more winter flooding exacerbating competition over allocated water resources.

Climate changes are likely to worsen food production supply primarily in all areas with unreliable rainfall. On the other hand the world population is projected to increase by 37%, and reach 9.2 billion people by 2050 (UNDP, 2006). It is the poor who are most vulnerable and constrained in terms of their options for adaptation. Yet from all these challenges then, how can we mitigate global dimming effects?

4.2. How to mitigate climate change effects on food supply?

The link between diming, brightening and crop production is complex and depends on the canopy structure and the accessibility of light diffusion. With the existence of dimming phenomena, the major risks are the famines connected with crops failure. Difficulties in developing countries began already facing decrease in crop yield. This drop in food supply requires increasing the awareness of the necessity of planting seed supplies of appropriate frost/cold-resistant crops (Wild, 2012). Sufficient knowledge among agricultural extension agents is necessary. Also, urgent agricultural and economic research should be in place.

It is likely that, in the short run, adjustments will be on the demand side since capital is fixed. But over time the supply side will respond as the capital stock is replaced. A credible economic instrument signals both. If the marginal cost of carbon is expected to rise over time, then a low tax can mitigate the costs in the short run when capital is fixed, while signaling a higher rate in the future. Successful cases such as the European countries adopt a mixture of policies. These comprise of energy taxes, emissions trading, support for renewable and energy efficiency, low-carbon technology support, international environmental aid, and numerous command-and-control rules.

These policies have typically been developed in an ad-hoc fashion, and have been subject to dynamic lobbying by vested interests and supported by overlapping and multiple agencies of government and voluntary bodies. Adaptation policy is a core solution to climate change in parallel with the precautionary policy to minimize the emission level. Dessai and Hulme (2004) proposed adaptation policy frame work; this conventional 'top-down' approach yielding adaptation and vulnerability estimates are increasingly seen as somewhat restrictive. Climate adaptation policies may be developed from either or both approaches.

Most adaptation policies show top-down emphasis, whereby emission models drive scenario models which in turn drive impact models. For agriculturalists, a more individual, and bottom-up response is common. This involves concepts of capacity, financial considerations and risk assessment. Farmers are well aware of the basic tenets of risk management or avoidance, and frequently show great willingness to adapt to

changing circumstances. A possible risk management approach for agriculturalists is based on United Nations Development Programme (UNDP) Adaptation Policy Framework, as shown in Figure 2.

Academics, governments, non-governmental organizations, businesses, civil societies and individuals; all need to provide simple vision or description of what a sustainable lifestyle will look like. A simple narrative will help companies and policy makers reconfigure their products and strategies for a world that will constitute nine billion people by the year 2050. I believe that consumers need to change their purchasing behaviour and producers need to produce environmental friendly products and overcome their self interest objectives.

5. Conclusion

Diming phenomenon requires global cooperation to merge the efforts between international and regional environmental authority in order to unify goals. This can happen by changing the consumers' and the corporate behaviour regarding environment. Especially in the light of the increasing demand was driven by the sharp increase in fuel prices. Both businessmen and consumers are aware of the volatility in the prices of fuel. This will be one of the main reasons behind consumers to change their behavior pattern towards environmentally friendly products. Thus, changing in the behavior pattern is purely driven by economical reasons.

The role of society pressure and driving organizations to be environmentally responsive is important for environment awareness and protection; the role of consumers continues to be contentious. From the supply side producers allocation to resources is more effective, as they have the ability to decrease the emission of harmful gases from entering the atmosphere. This is done via hybrid cars that save gas. Despite the actions taken from major car companies, hybrid cars which are based on a combination of an electric engine and gasoline need some adaptation by consumers. Thus, the consumer preference is a major thing in driving organizations towards green product development. Monitoring emission levels and urging for green technology to be used especially in developing countries because if one country starts to suffer the rest will catch up. Moreover, this urges for a shared vision agreement for sustainable practice to overcome dimming impact.

I believe that reimaging can assist major companies in providing a successful green business and demand. Social movements advocate active business leaders. This happens when businesses move beyond the narrow self interest of investors and employees for profit and move towards self interest of consumers and environmental aspects of their product and business process. Personally I believe that it is certain that consumerism affect corporation's environmentalism. However, the extent to which the corporation is affected depends on the way it operates its business process and product orientation.

In the context of consumerism, cars emissions are the single largest contributor to several pollutants, such as carbon dioxide and nitrous oxide (which are designated as GHG, green house gas, under the Kyoto Protocol); there were a lot of government initiatives for green action. Consequently, policy makers and ministries can set a precautionary approach and this requires a corporate social responsibility using energy.

Second, despite the difficulty, there is a need to reallocate human rights. In practice, though a permits scheme will play a major role in solving the problem especially within the Kyoto framework, it will be hedged around with other policy instruments. Also, the needs for agricultural and economic research to project the sudden global cooling location is crucial taking into consideration the importance of inter disciplinary relation between climatology, space sciences, volcanoes, and geology to estimate environmental problems impacts on agricultural products. On the other hand, civil society can engage in environmental awareness especially for farmers. They should provide them with adaptation techniques due to vulnerable climate changes. This vulnerability creates uncertainty which requires more awareness, education and government intervention.

Practically, no research was made to quantify the potential impacts or adaptation strategies for the food sector. The dependence of this sector on fossil fuel–based energy requires GHG mitigation policies to have substantial impacts on the national and global food system as it presently operates. From my point of view, in order to investigate an unclear factor we cannot conduct two cases in two different surroundings because green consumerism differs. A case in developing countries, adopting green consumers will actually exist; while in less developing countries (LDC), green consumers are theoretical (even if green consumer's exits in LDCs their awareness standards and behavior is entirely different than that of a green consumer in DCs). Although, in their cases in both countries consumers were found not to be a driven force for corporate environmentalism; this does not mean that the reasons behind this conclusion is the same. Environmental concerns are now a major socioeconomic issue and not a fringe issue anymore.

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APPENDIX

Figures

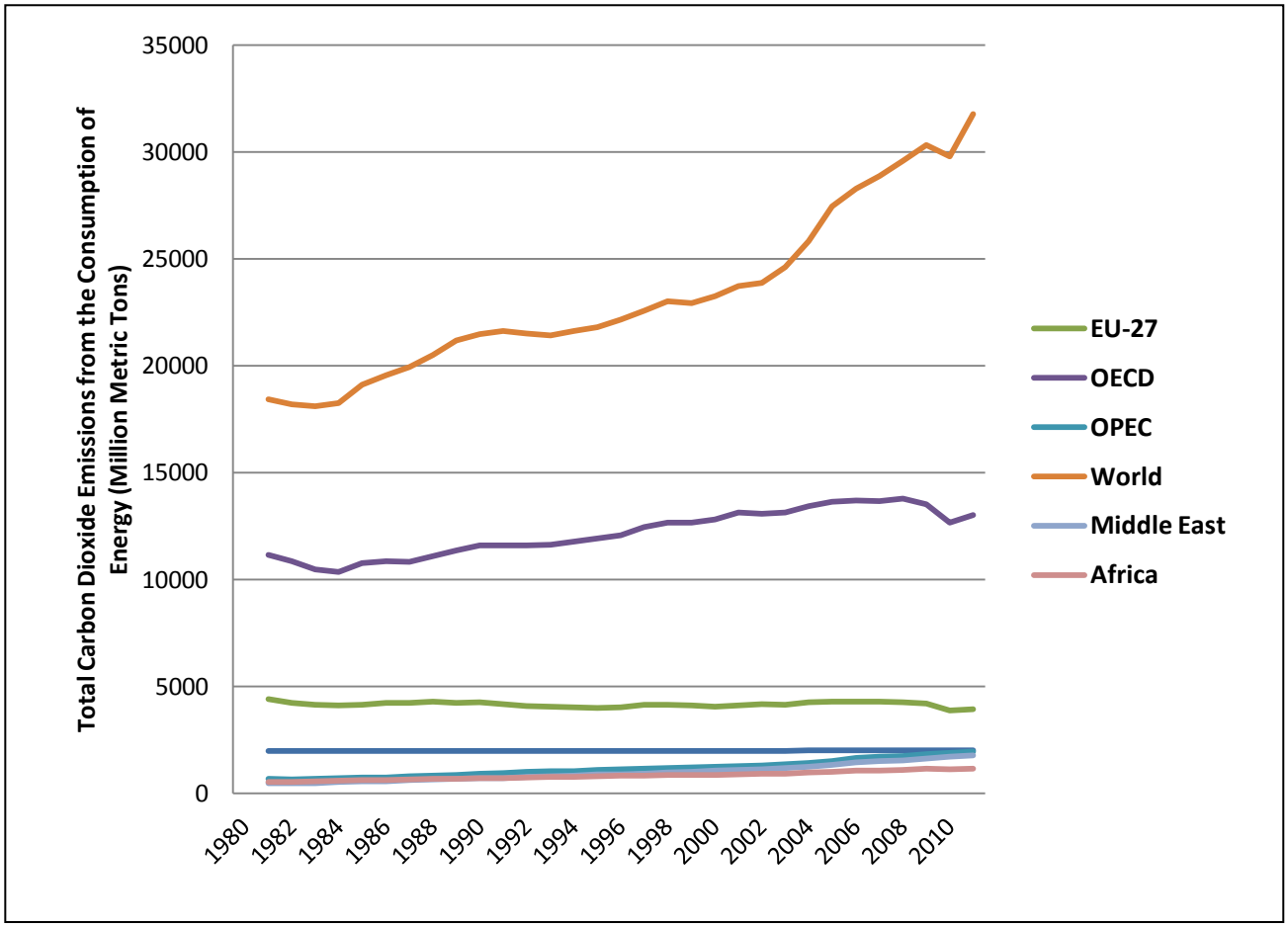


Figure 1. Total Carbon Dioxide Emissions from the Consumption of Energy (Million Metric Tons) (Source: Energy International Authority, 2012, www.eia.gov)

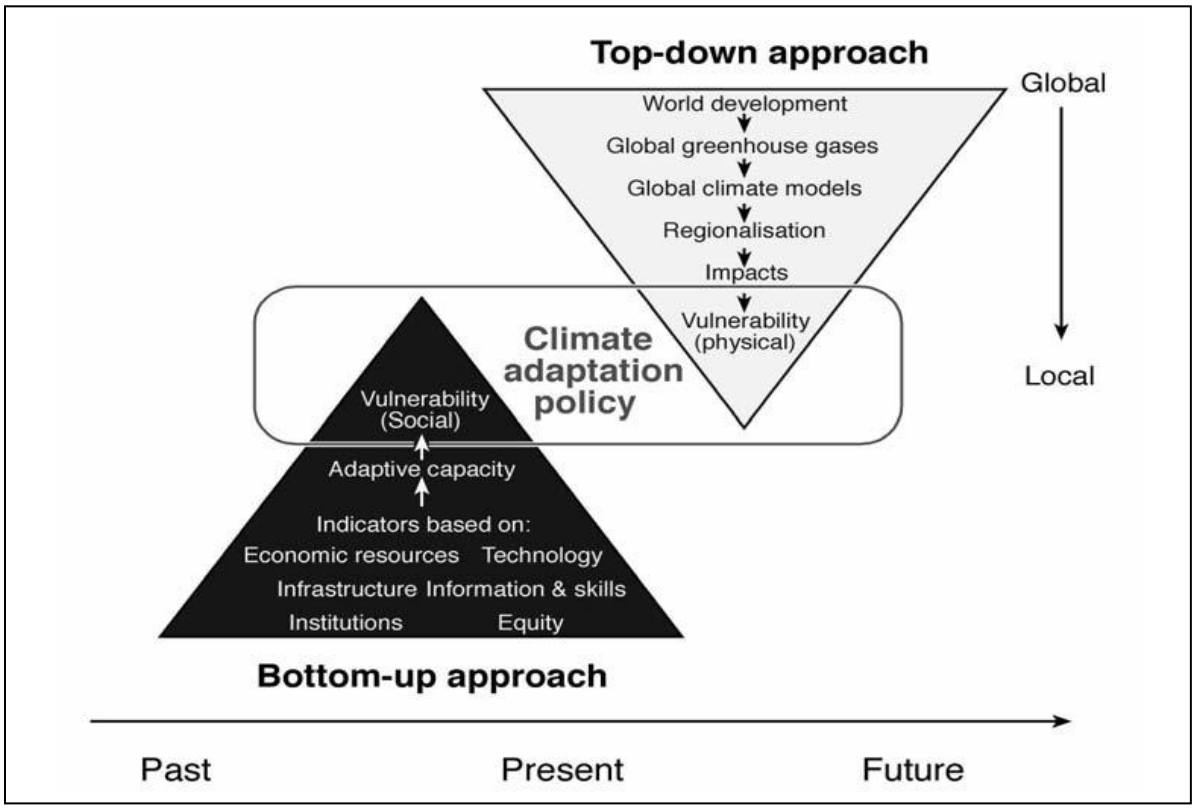


Figure 2. The top-down vs. bottom-up approach to climate adaptation policy (Source: Dessai and Hulme, 2004)

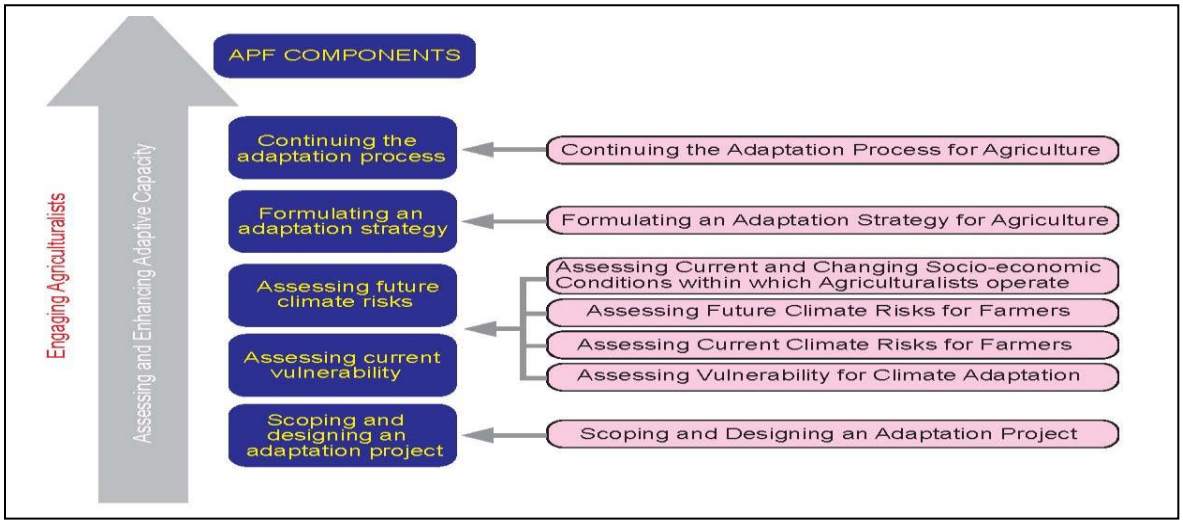


Figure 3. Adaptation Policy Framework (Source: United Nations Development Programme (UNDP) Adaptation Policy Framework, Lim et al., 2005)

Tables

Table 1. Examples of climate variability and extreme climate events and their impacts

Projected Changes during the 21st Century in Extreme Climate Phenomena and their Likelihood	Sample Examples of Projected Impacts(all high confidence of occurrence in some areas)
- Higher maximum temperatures, more hot days and heat waves over nearly all land areas (very likely)	- Increased incidence of death and serious illness in older age groups and poor urban. - Increased heat stress in livestock and wildlife. - Shift in tourist destinations. - Increased risk of damage to a number of crops. - Increased electric cooling demand and reduced energy supply reliability.
- Increased summer drying over most mid latitude continental interiors and associated risk of drought (*likely*)	- Decreased crop yields. - Increased damage to building foundations. - Decreased water resource quantity
- Intensified droughts and floods associated with El Niño events in many different regions (*likely*)	- Decreased agricultural and rangeland productivity in drought- and flood-prone regions. - Decreased hydro-power potential in drought-prone Regions
- Increased intensity of mid-latitude Storms *(little agreement between current models)*.	- Increased risks to human life and health. - Increased property and infrastructure losses. - Increased damage to coastal ecosystems

Source: IPCC 2001