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Climate change policies and their negative effects on food security

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Resumen

El cambio climático se ha convertido en uno de los temas más discutidos de los últimos años, tomando relevancia no solo en el ámbito ambiental, pero también en el político y social. La necesidad de encontrar políticas de adaptación y mitigación a este fenómeno han contribuido a la creación de mecanismos que buscan reducir las emisiones de gases de efecto invernadero, así como instrumentos para reemplazar los combustibles fósiles por nuevas fuentes energéticas, menos dañinas para el planeta. Sin embargo, algunas de estas políticas afectan negativamente el bienestar humano. Esta tesis presenta como existen políticas de cambio climático que afectan negativamente la seguridad alimentaria, presentando distintos casos en los que esta se ve afectada. Adicionalmente se incluyen recomendaciones a través de las cuales se podría mitigar los efectos del cambio climático sin vulnerar la seguridad alimentaria de las personas.

Palabras clave: Adaptación, biocombustibles, mitigación, políticas de cambio climático, seguridad alimentaria.

Abstract

Climate change has become one of the most discussed topics in the past couple of years, taking relevance not only on an environmental scope but also becoming important in the political and socioeconomic context. The necessity to find adaptation and mitigation policies for climate change has contributed to mechanisms that seek to reduce greenhouse gases emissions, as well as new energetic sources to replace fossil fuels. Nonetheless, some of these climate change policies affect human livelihood in a negative way. With the use of some examples, this thesis shows how certain environmental policies are detrimental for food security. In addition, further recommendations are made as models through which climate change could be mitigated without making people vulnerable to extreme situations, such as food insecurity.

Key words: Adaptation, biofuels, climate change policies, food security, mitigation.

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Introduction

Today, the issue of climate change is one of the most discussed topics among individuals and organizations, especially within the scientific community. The causes of climate change, be them anthropogenic or natural as a process of planet Earth, are of great concern for policy makers due to the perceived impacts of future scenarios caused by climate change and because they seek possible solutions that may lie behind global warming, or at least ways to mitigate or slow down this process. The number and magnitude of effects are large, as humans have already witnessed in the past couple of years with the continuous change of climatic patterns and their intensity. Each year droughts affect Eastern Africa or floods cause problems in Asia; yet, when talking about global warming, the picture of polar bears drowning and ice caps melting are the ones that are considered the most prominent effects of this phenomenon.

The dimensions of climate change go far beyond the effects it has on the temperature of the planet. It has social, political and even economical consequences. At the same time, the poor management of climate change policies can be far more dangerous, for example, affecting the livelihood of people that live in conditions of extreme poverty. As Anthony Giddens puts it:

> Global warming, other authors point out, is not the only danger created by humans that could wreak havoc with our way of life. Other threats come from nuclear proliferation, which could at some point converge with tensions initiated by global warming; from self-reproducing nanotechnology, particles of which could get through the skin, into the bloodstream and from there be carried to the brain; from a food crisis, producing levels of starvation and mass migration on a massive scale; or from runaway population growth. (2009: 28-29)

The issue presented before us is rather simple: human beings should do their best to mitigate climate change and reduce its consequences on society. Several policies at the local, national, and international levels have already been established around the world in order to tackle global warming, either by individuals or by institutions. However, this brings up other debates such as the one posed throughout this document: Can climate change policies affect other ways of human life? If so, how? In the case of this thesis, the approach is on food security, and how can these policies negatively affect them.

As several organizations, governments, and even individuals pursue to mitigate climate change, it is also important to consider the consequences it has on human livelihood beyond the economic and political perspective. As such, a simple question must be considered: can climate change policies, which are supposed to be beneficial, affect negatively human lives, for example in the case of food security? The supposition after the research made suggests that it does affect it negatively, even if it does not affect it directly, mainly through the establishment of policies of mitigation and adaptation to climate change. The IPCC Third Assessment Report defines climate change mitigation as an “intervention to reduce the sources or enhances the sinks or greenhouse gasses” (as cited in Klein et al., 2007; 750), while adaptation means the “adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harms or exploits beneficial opportunities” (as cited in Klein et al., 2007; 750).

Throughout this paper, mitigation and adaptation policies will be discussed and how both of them affect food security, a concept created in the World Food

Summit in Rome in 1996. According to the *Rome Declaration on World Food Security*, “food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). Although this excerpt explains how the term can be applied, in 2006 the concept was expanded, conveying four dimensions of food security: availability, access, utilization, and stability. This expanded concept “has enabled policy responses focused on the promotion and recovery of livelihood options” (FAO, 2006). Additionally, in order to measure the impact of climate change policies, this thesis focuses on several levels of food security: globally, nationally, and at a household level.

The Food and Agriculture Organization of the United Nations division of statistics (FAOSTAT) collects and distributes indicators on food and agriculture. It is the biggest, most complete corporate statistical database, with information compiled from 1961 to the present day, “containing records from over 245 countries and territories covering domains on agriculture […], nutrition, fisheries, forestry, food aid, land use and population” (FAO, 2013). Tools like this one are currently used to measure and compare data in order to analyze if whether a social settlement is vulnerable to food insecurity, if the land is properly distributed and used, as well as other purposes as well.

This paper aims to show how food security and climate change policies are correlated in a negative way, the former being a consequence of the latter. It is expected to show how poorly managed policies are detrimental for people living in conditions of vulnerability human beings, considering biofuels and the results they cause when analyzing the food security dimension. For instance, it will talk about

how biofuels affect food availability and access to food, both factors included in the FAO definition of food security.

Another point that will be addressed will be the legal frameworks that have been adopted as measures to mitigate climate change, such as conventions or international agreements. The case of the Kyoto Protocol will serve as an example to validate how ineffective these policies are, particularly because they do not take into account the humanitarian perspective of vulnerability to climate change; knowing that food security is undoubtedly imperiled because of climate variability, it is absurd not to consider it as a focal point when establishing climate change policies. Furthermore, the adaptability of people depends on how the weather patterns behave, considering that social conflicts, migratory flows, or economic disturbances may occur because of the inability to predict the unexpected changes in temperature.

There is an increasing necessity to find new energetic sources that satisfy the planet's requirements. Renewable sources such as solar, geothermal, or wind energy technologies are already being developed worldwide, reducing the dependence on fossil fuels that society has had since the Industrial Revolution. These technologies can possibly reduce the greenhouse gases (GHG) emissions that each country produces, mitigating the effects of climate change.

This thesis document will be divided into three main sections. The first one will address the literature review where the theoretical bases of the investigation will be established. In the second section, the methodological approach will be explained, as well as the limitations that were presented when choosing it. The third part includes the results of the research; the fourth section contains the

concluding remarks, in which the author sums up the whole investigation while including her unanswered doubts and questions that appeared during the research. Finally, the last section includes the recommendations of the author for future documents that include both perspectives of environmental policies and food security, while also considering new alternatives for policymaking instruments, as well as the possibility to improve the mechanisms that have not been effective. In addition, there is a glossary and an index, as well as two annexes, which will help the reader on a more profound basis the impacts of biofuels in the case of Annex I, and to analyze the volatility of food prices in the case of Annex II.

Literature Review

For the past fifty years, concerns over the environment and the implications of climate change have grown significantly, particularly because it is no longer a myth since observable evidence has demonstrated that it is actually happening. This has been achieved through the use of tools such as the Keeling curve (see Figure 1), which determines "the increasing CO_2 content of the atmosphere since 1958, as measured at the top of Mauna Loa volcano, Hawaii" (Mathez, 2009; Figure 1.2), or other mechanisms that allow to measure the fluctuation of temperatures between 1961 and 1990 (Mathez, 2009; Figure 1.3).

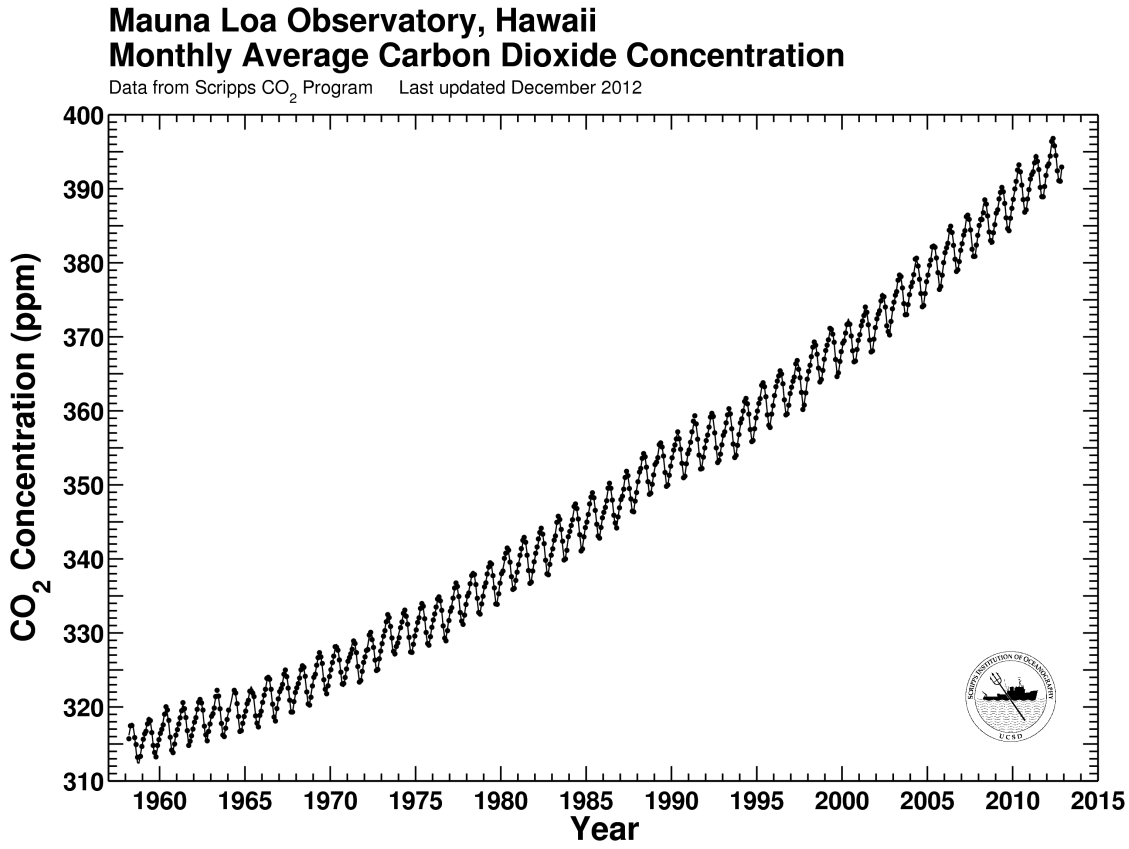

Figure 1. Keeling Curve
Data retrieved from Scripps CO_2 Program (2012).

Recent studies have demonstrated that the most vulnerable states are developing countries in Africa--which suffer from extreme droughts--or Asia--which

go under distress because of massive floods or monsoons. However, this does not imply that these are the only ones that suffer from climate change. As it is a global problem, all countries of the world are affected by it; “the effects of that warming can be found in the largest phenomena. The oceans that cover most of the planet’s surface are clearly rising, both because of melting glaciers and because waters expands as it warms. As a result, low-lying Pacific islands already report surges of water washing across the atolls” (McKibben, 2000; 397).

When consulting with the Clemencia Vela (2013) an expert in environmental sciences, she mentioned that there are many other problems that happen due to climate change. One of them is the rise of the ocean level, which could carry not only political consequences such as provoking mass migratory flows of vulnerable people to other countries, whom would then suffer from social consequences such as conflicts or food crises. When analyzing the climatic change scenarios, it is important to take into account that there has been a shift in the patterns of climate; while seasons were well established along the year, now there are unexpected snowfalls in the middle of October in South Australia (Once-in-century October snow across SA, 2012), meaning that the certainty that many people counted upon before is now gone.

Another issue Vela (2013) interprets as something that should be given more responsiveness is the shift of the patterns of intensity of climate change. It is obvious that during winter the temperature will drop, or that during summer temperature will rise. But according to Bhattacharya (2003), the heat wave across Europe in August of 2003 accounted for an estimated of 35,000 lives. In his article, the author claimed that the Earth Policy Institute stated how floods, tornadoes and

hurricanes are not as lethal as heat waves (Bhattacharya, 2003), but that does not mean by any chance that the aforementioned phenomena should be neglected or that states should not be prepared to mitigate the effects they may provoke.

Fisher notes that “the damage inflicted on the environment is increasingly evident: arable lands lost to erosion, salinity, desertification, and urban spread; disappearing forests and loss of biodiversity; and emerging water scarcity. This situation will be further exacerbated by climate change as well as extreme weather events and climate variability that are increasing in frequency and severity. All this will further increase the social, economic and environmental vulnerability of large proportions of the population of developing countries” (2009; 30-31). This highlights why climate change and environmental degradation must be considered as a global social problem that needs to be addressed immediately, given the fact that it does not only deal with the ecological consequences of the rises of temperatures, but it has major impacts on health, agriculture, economy, immigration policies, and the political discourse of states’ leaders or the discourse of international organizations.

Much of the environmental degradation has been blamed on anthropogenic causes, such as human beings’ addiction to fuel. David King suggest that “we need to actively reduce our dependence on fossil fuels, moving to a low-cost, carbon-free energy system, focusing on renewables and on energy-efficiency gains” (2005; 781). McKibben states that “the UN’s Intergovernmental Panel on Climate Change projects that an immediate 60 percent reduction in fossil-fuel use is necessary just to stabilize climate at the current level of disruption. Nature may still meet us halfway, but halfway is still a long way from where we are now” (2000;

399). What can be done? States all over the world have developed a wide range of policies to deal with climate change, which go from local level policies to an international level ones; most of them can be summed up in three groups: legal frameworks, mitigation policies and adaptation policies.

Legal frameworks are mostly drawn at an institutional level and it is carried on either regionally or internationally. For example, the Kyoto Protocol is an international agreement that is associated with the United Nations Framework Convention on Climate Change. It was signed in December 1997 and it stipulates that, from 2008 to 2012 greenhouse gases (GHG) emissions should be reduced (United Nations Framework Convention of Climate Change, 1998). Nevertheless, in December 2012, the COP18 Conference of the United Nations Framework Convention on Climate Change in Doha, Qatar agreed to extend the finalization of the Kyoto Protocol, under the second commitment period from 2013 to 2020 (United Nations Development Program Climate Community, 2012; 1). This represents a new opportunity: the original protocol does not include the human rights' perspective into account, and if a new treaty is to be created, it can be more specific towards this topic, specifically on how climate change represents a danger to human beings. In the case of this particular thesis, the approach taken is towards food security, even if there are other ways in which climate change can affect human lives such as the increase of natural disasters or the escalation of migratory flows, as was mentioned before.

Secondly, mitigation policies, such as creating carbon markets or establishing food security strategies, have been created in order to avoid the possible effects that global warming may bring; essentially, "food security, rural

development, energy security and climate change mitigation are all critical to social, economic and environmental sustainability at national to global levels." (Fischer, 2009; 180) In order to ensure the effectiveness of such policies, international cooperation is encouraged because this would reduce the costs of implementing the policies for all countries while bringing benefits for all of them at the same time.

Finally, "adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change" (Smit et al., 2001; 879). These policies are the third aspect of coping mechanisms that have been developed, but the difference between mitigation and adaptation is that the former refers to deal with the possible consequences before they occur and the latter one is managing what has already happened and cannot be corrected. Adaptation programs also differ from mitigation because they usually work on a multilevel scale, meaning they involve several sectors of civil society to address the issues that have been caused by climate change. Some adaptation policies include promoting the efficient use of water resources, encouraging the development of low-cost technologies for desalinating seawater, instituting vaccination programs, encouraging the preservation of green corridors, developing early-warning systems, and encouraging the development and use of drought-resistant crops (Congressional Budget Office, 2005; 36).

Acknowledging that climate change is indeed a multidimensional global problem that affects the human livelihood in several aspects, "global climate

change will have diverse impacts on human health – some positive, most negative. Changes in the frequency and intensity of extreme heat and cold, floods and droughts, and the profile of local air pollution and aeroallergens will directly affect population health. Other effects on population health will result from the impacts of climate change on ecological and social systems" (Smith, J. B. et al., 2001; 939), such as infectious disease occurrence, local food production, and nutritional adequacy, among others. Furthermore, "for each anticipated adverse health impact, there is a range of social, institutional, technological, and behavioral adaptation options that could lessen that impact" (Smith, J. B. et al., 2001; 939), or even worsen it.

In spite of the negative aspects of climate change that have been analyzed up to this point, it is important to mention that there is still hope: many incentives have been made to ensure a sustainable environment and to end poverty in the process. Steven Smith mentions several alternatives that have been created worldwide, from The Suledo Forest Community project in Tanzania, which seeks to sustain the forest's life, to the implementation of Food Security and a Greener Urban Environment in the Lima slums in Peru (Smith, S. C., 2005). Many things can be done nowadays and in the future, with or without the imminent threat of climate change; however, more creative and inventive mechanisms are needed, as well as some passion and willingness in order to make things better in spite of the unfavorable environmental situation.

Environmental degradation is a fact that cannot be ignored. It has been neglected for a long time. In the last two decades however, scientists, civil society, ecologists, anthropologists, agronomists, doctors, and the world population in

general have taken climate change as a priority. The investigations have shown how climate change has progressed, how temperatures have slowly risen, how desertification and erosion have gradually taken over a great number of regions, how the poles have increasingly melted and the water levels have endangered not only flora and fauna, but also human beings.

The continuous use of non-renewable energetic sources such as oil, natural gas and carbon has had an enormous impact in the emission of greenhouse gases (GHG), especially since the Industrial Revolution. In the *UN Guide to Climate Neutrality*, Alex Kirby (2008) talks about a notorious dependency to fossil fuels (80% of the energy supply of the planet), This would explain why there is permanent research for possible energy replacements, with a focus on renewable resources. The population growth in the last two decades, the non-stopping economic development of countries such as Brazil, Russia, India or China, and the increase in GHG emission rates come due to the excessive use of fossil fuels (34). In order to stop the dependence on fossil fuels, and to avoid the increase of GHG emission rates, it is of utmost importance to find new energy sources that are capable of satisfying the needs of the planet.

The implicit necessity that undergoes with the responsibility of finding new energy sources such as solar, geothermal, hydric, tidal, and wind energy, among others, comes under the need to reduce GHG emissions and to avoid any dramatic increase in temperature over the next decades. Giddens extends the list of technologies that are also in play: “purified coal (carbon capture and sequestration, or CCS) […]; smart electricity grids; geo-engineering technologies, such as heat shields that would turn back a proportion of the sun's rays; and

'scrubbers' - devices that would suck CO_2 and other greenhouse gases out of the atmosphere" (2009; 131). Many of these examples may indeed be valid possibilities to gradually respond to the energy requirements of the planet in the future. However, an innovative source that has already taken force over the past years has been the use of biofuels.

Biofuels can be defined as "converting grain or other biomass into ethanol is currently a popular idea, but it is not a new one. It requires fertile soil, large quantities of water, and sunlight for green plant production" (Pimentel, 2006; 875). This dissertation seeks to demonstrate how policies of adaptation and mitigation that battle climate change can also have antithetical effects in the life of planet. In the case of biofuels, the most common effects are those derived from great plantations such as severe erosion, soil poisoning due to fertilizers and pesticides, and, paradoxically, this contributes immensely to global warming (2006; 875). Beyond such effects, these policies clearly have a particularly negative effect on human beings considering that, "using food crops, such as corn grain, to produce ethanol also raises major ethical concerns. […] Growing crops to provide fuel squanders resources; better options to reduce our dependence on oil are available" (2006; 875). There are other consequences such as the contamination of water due to the consumption of thousands of gallons, destined to the production of such crops. Giddens (2009) claims that, "widespread enthusiasm for the use of biofuels has diminished as it has become clear that growing them can seriously affect world food production" (133); however, Giddens did not specify that these are first-generation biofuels.

First-generation biofuels are those made from crops, such as corn, soy,

sugarcane, among others, which have a direct impact on food security. Second-generation biofuels are made from lignocellulosic biomass, which mainly comes out of leaves, branches, wood and inedible parts of plants (What is lignocellulosic biomass?). Nonetheless, second-generation biofuels are still in the experimental phase. As Fischer puts it:

> In the long run current first-generation biofuels production on cultivated land is not tenable as the world's limited arable land resources are essential to meet future food demand. Hence it is important to make a fast transition to producing second-generation biofuels from lignocellulosic feedstocks such as perennial grasses and tree species. (2009; 24)

Still, countries that produce first-generation biofuels, such as the United States or Brazil, have established policies or incentives nationally, for example, the Brazilian government "mandated that all diesel contain two percent biodiesel by 2008 and five percent biodiesel by 2013" (Ford Runge and Senauer, 2007; 44). At the moment, technological breakthroughs are still needed to transfer to a second-generation biofuel based path, meaning that these new technologies are still years –maybe even decades– away from developing towards biofuels that do not put food security in danger.

Now, first-generation biofuels are divided into two categories as well, those that become ethanol and those that become biodiesel. Fischer (2009) says, "ethanol can be produced from any feedstock that contains a high starch or sugar content, such as maize, wheat, sugar cane, and sugar beet, by the fermentation of carbohydrates" (34) implying that ethanol is made mostly from crops that are food. Following ethanol comes biodiesel, "produced through a chemical process called transesterification of vegetable oils from crop plants such as oil palm, rapeseed, soya bean, and jatropha" (Fischer, 2009; 34). In the end, the production of both

ethanol and biodiesel produce a raise in agricultural prices, increasing the risk of hunger and food insecurity.

As shown above, the battle against global warming is now a part of daily life, and there are several policies that seek to alleviate climate change. From adaptation to mitigation, these policies seek to ensure a sustainable future for the planet. However, while these policies are taking effect, they are causing negative effects on the livelihood of human beings, simultaneously making people more vulnerable to any possible environmental debacle. The next sections will include the results of the research, explaining how it is possible for climate change policies to affect food security negatively.

Methodology

Given the fact that the research was purely theoretical and no field-based investigation was made, the methodology used in this thesis will be qualitative analysis. The premise given in the paper suggests that the effects of climate change policies have over food security do not occur in an immediate period of time but rather in the long-term, making it harder to obtain observable results of the examination. Nevertheless, the data collected from the sources makes it easy to infer possible outcomes and to assume the existence of a correlation between climate change policies and its negative effect on food security.

The expected outcomes would also be drawn out from prior investigations made by others, which foresee similar probabilities in the spectrum of food security and its relation to climate change policies. Although the results are not necessarily based on first-hand evidence, there is enough substantiation to support this paper's hypothesis. That being said, the methodology that will be used throughout this thesis will allow a personal analysis from the author, which will give some insight into the future of climate change policies and how to avoid its negative impact on food security.

Limitations of the Methodology

Taking into account that this topic is still relatively new and that there are not many sources that address it directly, one of the difficulties that occurred while preparing this document was to connect the two big subjects –climate change policies on one hand, and food security on the other.

Since this thesis was based on theoretical premises and empirical knowledge instead of evidence from field investigation, the results are intangible; they are enough to support the hypothesis of this paper, which assumed that climate change policies have negative effects on food security. Although the study focuses on the present situation, enough evidence was collected that points to future, more severe challenges between climate change policies and their direct implication with food security and its vulnerability.

Results

Based on the evidence that was obtained while researching for this thesis, it is now clear that climate change policies do affect food security in a negative manner. In the case of policies that seek for alternate sources of energy, biofuels have been taken as an example to show how new energies become more attractive to replace fossil fuels. Nonetheless, biofuels carry several consequences for agriculture and for food security as well.

At the moment the world is still at the stage of producing first-generation biofuels only, implying the ones that are based on food crops, meaning that maize, soy, cereals, sugarcane, among others would be used for the energy industry instead for food production. Comparing the data of the 2008-2010 period with the 2020 estimates of the Agricultural Outlook prepared by the OECD/FAO (2011), the following data appears:

> By 2020, 12% of the global production of coarse grains will be used to produce ethanol compared to 11% on average over the 2008-2010 period 16% of the global production of vegetable oil will be used to produce biodiesel compared to 11% on average over the 2008-2010 period and 33% of the global production of sugar compared to 21% on average over the 2008-2010 period. Over the projection period, 21% of the global coarse grains production's increase, 29% of the global vegetable oil production's increase and 68% of the global sugar cane production's increase are expected to go to biofuels. (86)

This exemplifies the dangers of poor management of biofuels policies, particularly in developing countries that suffer from regular food crises. One of the possibilities that came across as a possible solution was administrating programs that ensure the use of second-generation biofuels. Even if that kind of technology is still years away from reach, the careful and responsible handling of biodiesel and ethanol production will reduce the probability of food insecurity.

A second issue that occurs as a consequence of the biofuel industry is the surge of prices in crops that are used in the production of ethanol or biodiesel. Food prices are somewhat unpredictable year-by-year, depending on how the climatic scenario contributed for the production or lack thereof of certain feedstocks. As said in the previous section, special regard must be taken for the changes in the patterns of climate change and the patterns of intensity, not only because these affect human livelihood, but also because they have repercussions on agriculture and the vulnerability of food security. The scarcity of a certain feedstock plus a governmental policy that commands the production of biofuels based on those crops implies that the national prices would rise, making the population vulnerable to food insecurity both at a national and at a household scale. When this happens simultaneously in multiple countries, a global food crisis occurs, and such humanitarian emergencies become the focus of the world.

Thirdly, there is a double-edged outcome of biofuels that affects not only food security but, ironically, the environment as well. One of the requirements to produce biofuels is to have major plantations of the feedstock crop that will be used to produce either ethanol or biodiesel. As discussed on the previous paragraphs, this carries consequences such as the pollution of water, which can be associated to food insecurity and agriculture, and erosion of the land, loss of biodiversity, and the poisoning of soils and air as a negative effect for the environment itself.

Fourthly, even if second-generation biofuels are more energy-efficient than first-generation biofuels, there is the possibility that humans will reach a tipping point where the concern for the environment passes to a second degree and

biofuel production continues under BAU [1] policies, promoting deforestation. According to Giddens (2009), "about 25 per cent of CO_2 emissions over the past two centuries have come from changes in land use, of which deforestation is by far the biggest contributor" (225). Considering the hypothetical case where it is impossible to produce lignocellulosic biomass because of scarce resources –in this case, lack of trees due to the extreme deforestation–, there is a slight chance that first-generation biofuels would be reconsidered as a source of energy.

As seen paramount, there are several sources from which ethanol and biodiesel can be obtained. Bioethanol can be obtained either through crops rich in sugar, such as sugar cane or sugar beets, or rich in starch, such as maize, wheat, barley and other cereals. Nonetheless, there is the likelihood that cassava is a potential ethanol feedstock in the future for biofuel production, for several reasons, such as yielding high levels of starch, being a crop that can be grown year-round, and it responds to the food security needs, being a source rich in carbohydrates. Take into account that "the crop yields an amount of woody and lignocellulosic biomass from the shrub that is currently not being used, but which could make a future feedstock for second-generation biofuels or provide energy for processing" (Fischer, 2009; 95).

On the same note, the various sources for biodiesel, such as palm, rapeseed, and soybean also have all different uses beyond the creation of vegetable oil. The results of the research indicate that palm oil is the most suitable source for industrial processing and even as an energy source in the case of biodiesel, it outperforms any source of edible oil, yet, according to Kleffmann

[1] Business As Usual
[2] Annex I includes a table of several feedstocks (both first and second-generation),

(2007) it only accounts for 1% of biofuel production (as cited by Fischer, 2009; 109); at the same time, rapeseed oil, better known as canola oil, which is one of the major edible vegetable oils and brings health benefits due to its high content of omega 6 and omega 3, is still used as biofuel feedstock, and soybean oil devotes 6% exclusively for human food while 25% and growing are devoted to biodiesel production. Palm oil could easily replace rapeseed oil and soybean oil because it is a more productive and a higher yielding oil crop; yet, this shows how biofuels policies endanger food security, by using nutritious sources for energy purposes instead for human consumption[2].

When talking about agriculture and forestry, much is talked about how crops or plants in general should have adaptive capacities and be resilient to climate change. However, it is also important to mention that human beings should build resilience to natural disasters, and that they should also develop adaptive capacities prior to the happening of cataclysms (mitigation) and for the moment when a catastrophe takes place (adaptation). As such, resilience should be considered as one of the most important qualities of people, particularly when trying to battle vulnerability and food insecurity. The DFID/UKaid (2011) paper suggests several types and levels of resilience that should be used when facing an unexpected event; on one hand, the levels include the household/community scale, the municipal or local level, the national level, and finally the regional and global level, while on the other hand there are five different resilience building

[2] Annex I includes a table of several feedstocks (both first and second-generation), its impact on biodiversity and its efficiency

activities: social/human, financial/economic, environmental/natural, political, and technological/physical (11).

By establishing resilience activities that involve communities at all levels of society, it is possible to say that a new way of policymaking is on the way of being created: one that is inclusive and that could actually be effective when confronting the climatic scenario. If adequate mechanisms are launched, people will be able to handle the situation in an effective manner, reducing the possible damages to the environment. In exchange, this would serve as an effective example of political, social and environmental policy that prepares mankind for any event, and reduces the probability of having vulnerable people due to food insecurity.

Conclusions

After all the research, the major accomplishment obtained from this thesis was the possibility to answer the question initially posed, and to show that certain environmental policies may indeed be negative for food security. However, it is impossible to generalize because, as seen throughout this paper, there are certain climate change strategies that will benefit food security, as it was the case of promoting the use of cassava as a new source of bioethanol. Additionally, taking into account that climate change and food insecurity are global social problems such as extreme poverty or human rights violations, it is of utmost importance to remember that it is almost impossible to solve only one of these issues; to resolve them, the structural causes that lie underneath must be addressed.

The first fundamental issue of this thesis centers on is the different types of policies that deal with climate change. In this thesis the discussion centered on basically two of them, mitigation and adaptation. However, one must not overlook the fact that these two categories have several manners of handling the environmental resilience globally, locally or even at household levels. It is important to mention that although legal frameworks are considered as a third kind of policy, the most important aspect would be the institutionalism behind it, given that the cases where policymaking follow economic interests rather than the common good are frequently criticized and undermine the legitimacy of such entities, such as the Kyoto Protocol.

The second, yet pivotal argument, is the issue of food security and the evolution of its vulnerability over the years, with persistent food crises in regions like Africa and Southeast Asia and multiple peaks in food prices (Hart, 2009; 363).

Taking into account that these events have affected people not only individually, but also on several levels, going from a household scale to a national, regional and even global level. As Von Braun (2007) and Evans (2009) mention, “given the changes in the global food system this century, and in terms of new drivers of food demand, supply and pricing, it seems likely that low food prices are a thing of the past” (as cited in Hart, 2009; 365), confirming the supposition that food insecurity will continue in the future, in this case, because of the volatility of food prices.

One of the conclusions reached after the research for this dissertation was that although there are many possible new sources of energy that can be used to replace the dependence on fossil fuels, particularly renewable sources such as solar, tidal, or wind energy, human beings have focused mainly on the development of biofuels as an alternative to gasoline and diesel. However, after analyzing the correlation of biofuels and food security, it is clear that it is the least viable solution for the long-term, and although it will produce the biggest economic revenue in the short- to middle-term, it will provoke more food insecurity and backfire on the environmental scope.

In spite of the negative effects that some climate change policies have on food security, it is also important to contemplate that these two concepts are not mutually exclusive. While big international organizations such as the FAO propose that small farmers are the solution to food insecurity, policymakers suggest to develop programs based on “agroecology, farmers’ knowledge, and new partnerships among farmers, scientists and other stakeholders” (Giovannucci, 2012; 40). Furthermore, Giovannucci (2012) also mentions how governments have “signed international agreements that bind them to human rights and

environmental obligations. This, as well as guidelines on the right to food, should be a reference point for immediate action" (40), annulling any premise that would suppose that environmental policies and food security were opposites.

The environment may not be what it was a hundred years ago, or even twenty years ago, but that does not mean that people should remain immovable towards a phenomenon of such magnitude. The patterns of climate and the patterns of intensity have shifted over the time, making us vulnerable and less prepared to any natural disaster that comes. That is why it is of utmost importance that climate change policies are formulated in a responsible and intelligent way. Negligence and the poor management of such procedures may have negative consequences on food security, as it was discussed throughout this thesis. The management of strategies and guidelines that seek to mitigate and adapt to climate change will not go wrong and will ensure the success of such policies in the future.

Climate change and environmental degradation may be topics that people openly discuss about, but the implications behind the policies that try to mitigate the effects of climate change must also be taken into consideration. The lack of knowledge about these strategies makes people vulnerable in cases of extreme weather conditions, and the failure to prepare for such catastrophes result in various social and economic situations, such as mass migratory movements, humanitarian crises, and/or food insecurity for people. Thus, the environmental discourse should not only be kept for policymakers while the consequences of climate change are debated at grassroots levels; it is important that all levels of

society are conscious about the risks and the tasks they should play in case of a natural disaster.

To many, the first thing that comes to mind when talking about climate change policies is the Kyoto Protocol. These kinds of environmental policies usually lead to mechanisms such as carbon markets and strategies that limit the amount of GHGs. Yet, it was difficult to find evidence that pointed that carbon emission trading had any relation to food security and the food market, especially to the volatility of food prices. Initially, the goal of this paper was to link all possible kinds of climate change policies with affecting food security on a negative way, but this was not the case, either because information was not enough or maybe because there was no implicit correlation.

However, this study demonstrated how there is a lack of information on how climate change policies can “backfire” and have negative effects on people. Then it is important to ponder upon what are the things that are really best for the planet, because what does it matter if the environment is safe if all the people starved to death?

Recommendations

Although this thesis aimed to show that climate change policies has negative effects on food security, it does not mean that there are policies that contribute to battle vulnerability. Considering the example of carbon taxes mentioned by Giddens (2009), it would be an approach that combines "incentives and sanctions. By means of incentives, households would be persuaded to implement energy-efficient measures; a 'climate change surcharge' would be imposed on all households which, after a certain time, had not taken steps to carry out these measures" (153). Taking into account that taxation policies vary from state to state, it is just a simple example to show how the incentives would make the impoverished citizens earn more for each energy-efficient mechanism than the affluent citizens, and also how the surcharge could be used to subsidize agricultural plots of nutritious crops that would counteract food insecurity.

While investigating, it was disappointing to see how the international legal frameworks that address climate change actually do not take into account the humanitarian perspective, or do so thoughtlessly. To many, the Kyoto Protocol is completely ineffective. Giddens (2009) himself mentions that, "the Kyoto agreements have been widely dismissed – with a goodly dose of irony – as 'hot air'" (189), and while the initial period of 2008-2012 was supposed to be a "learning period", nothing changed for the second commitment period from 2013 to 2020. Indeed, Cohen (2008) mentions that, "agriculture, food and nutrition issues need to be placed onto national and international climate change agendas, in order to devise effective and pro-poor policies. The expiration of the Kyoto

Protocol in 2012 offers an opportunity to bring these issues to the table as a new agreement is negotiated" (70), yet, nothing has been done.

As such, it is highly recommended that if any new legal instrument concerning climate change is to be implemented internationally, it should take into consideration all dimensions that make human beings vulnerable, not only to weather but to the policies as well. Bals et al. (2008) believe that,

> The persons affected by drought, flooding, weather anomalies etc. are often experienced adaptation „experts". They should be informed and their opinions heard before adaptation decisions are made. Moreover, they should have opportunities to complain, be it to a national ombudsman system, or to the national human rights institution. If these people are negatively affected by the chosen adaptation policies or if they feel that their claims are overseen, there should be a route for citizens in which they can object to unfair policies. (123)

Although this proposal would in fact contribute to the application legal mechanisms if established through international institutions such as the United Nations or through regional organizations like ASEAN, the most important element is that it includes the direct input and testimony of people who experience how climate change or even climate change policies affect them. Moreover, it would strengthen the participation of civil society globally, nationally, and if managed in a proper way, it could reach communities and the household scale, making possible that everyone is involved in the policymaking process. This would allow local and national authorities know whether human rights are respected everywhere, if there are situations of vulnerable groups because of conflicts, or even if there is food insecurity because of high food prices or simply because one of the requisites is not accomplished. Tools such as FAOSTAT (FAO, 2012) and the analysis of food costs of previous years suggest a notorious trend of surges in the food market that

won't end in the immediate future[3], so this could also be a gadget that governments can employ in order to establish effective legislation depending on the local condition.

Another suggestion is the review of the Universal Declaration of Human Rights and similar documents to include specific rights such as the right to food or the right to live in a healthy environment. It is impossible to talk about human rights as an isolated issue, especially in a globalized world. But considering that many global social problems are intertwined, there is a particular need to address the systemic roots of such problems. The root causes of gender inequality, environmental destruction, extreme poverty, food insecurity, and conflicts, among others, depend on each other to be solved completely. As Pogge (2000) says,

> The fulfillment of human rights in most countries is strongly affected not merely by national factors (culture, power structures, natural environment, level of technical and economic development), but also by global ones. Explanations in terms of national and global factors do not simply compete with each other. Only their synthesis […] this is so, because the effects of national factors are often strongly affected by global factors (and *vice versa*) and because global factors strongly shape those national factors themselves (though the inverse influence is generally slight). (61)

If the systemic causes are addressed properly, new policies, including those regarding climate change, will surely overcome the marginalization of human rights and in the case of this particular investigation, will ensure the right of people to adequate food.

Although the agencies of the United Nations are independent, institutional cooperation, commitment and codependence among them is of strategic importance, specifically when it comes to address climate change policies and its

[3] Refer to Annex II to See the Annual Food Price Indices Data, from 1990 to 2012.

linkage to food security; for example, the United Nations Environmental Program should work together with the Food and Agriculture Organization and the World Food Program when drafting policies in order to have a fuller view on the possible outcomes. For the UN itself, a recommendation that could work is the establishment of a legally binding mechanism that includes all member states and encourages them to participate under the previously mentioned incentives/sanctions method; instead of forcing tremendous economic sanctions, these could be environmentally related, such as reforestation, agrobiodiversity management, or the establishment of renewable energetic technologies.

New alternatives for biofuels can be used, as it is the case of cassava in the case of bioethanol or jatropha in the case of biodiesel. For the latter, jatropha oil feedstocks could easily replace rapeseed oil and soybean feedstocks once that results are obtained according to the studies that are currently taking place (Fischer, 2009; 116). If Fischer's (2009) suppositions are accurate, not only jatropha oil will be suitable for biofuel production, but also as a source for mitigation in that it "is claimed to be useful for: soil and water conservation, soil reclamation, erosion control, living fences, firewood, green manure, lighting fuel, medicinal application" and could serve as a natural fertilizer as well as pesticide to kill larvae (113-114). It would not jeopardize food security since it is not edible and its compounds are highly toxic. As such, jatropha is an alternative that could produce biofuels in a short to medium term plan, but later on can be used as an agricultural technique for mitigating the effects of climate change.

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Glossary

Adaptation: adjustments that respond to the climatic impacts, managing the consequences of what has already been done.

Biodiesel: type of biofuel produced from vegetable oils.

Biofuel: fuel made from alternative sources, such as corn, sugar cane, or vegetable oil, in order to reduce the use of fossil fuels.

First-generation biofuels: biofuels made from crops or feedstocks.

Second-generation biofuels: biofuels made from lignocellulosic biomass.

Climate change policies: strategies established at local, national or even at a global level in order to mitigate the effects of climate change.

Ethanol: type of biofuel is made from starch or sugar-based crops.

Food security: situation when people have access to safe, sufficient and nutritious food; this includes four dimensions: accessibility, availability, utilization and stability.

Mitigation: policies that prevent the damages of climatic impacts, managing the possible consequences before they occur.

Annex I

Feedstock specific biodiversity effects Table 2.5 - 8

Feedstock type	Typical land converted or used	Environmental Problems	Impact on bio-diversity	Premium for bio-fuel
Oil palm	Virgin forest	Monocultures/Irreversible destruction of virgin forest (bush fires)	Very high	High oil yields
Sugarcane	Grassland/ cultivated land	Monocultures/biotech/processing pollution	High	Efficient ethanol production
Maize	Cultivated land	Monocultures/biotech/agro chemicals/erosion	High	Agronomic easy, low efficiency
Cassava	Cultivated land/grassland/ forest land	Competing with use as food crop	Neutral	In testing stage. High expectations
Rape	Cultivated land	Monocultures/biotech/agro chemicals/erosion	High	Simple technology but low efficiency
Soybean	Grassland/cultivated land/ forest land	Monocultures/biotech/agro chemicals/erosion. Direct and indirect intrusion in biodiverse ecosystems	Very high	Agronomic easy, low efficiency
Jatropha	Grassland/cultivated land	Monocultures/socioeconomic and agronomic uncertainties, toxic, invasive. Not domesticated	Neutral	Uncertain relative high oil yields claimed
Switchgrass	Grassland/cultivated land	Monocultures/tall/long rotations/competing with food crops	Neutral to positive	Second generation, high yields, high efficiency
RCG	Grassland/wetland	Monocultures/long rotations. Best on wetland, invasive forms natural monocultures	Mod.high to neutral	Second gen., moderately high yields, high efficiency, adapted to cold environments
Miscanthus	Grassland/cultivated land	Monocultures/tall/ long rotations	Neutral positive	Second generation, high yields, high efficiency
Willow	Grassland/ woodland/wetland	Best on wetland/ agrochemicals in case of SCR	Mod.high to neutral	Second generation, high yields, high efficiency
Poplar	Grassland/woodland/ cultivated land	Monocultures agrochemicals in case of SSR or SCR (biotech- advanced hybridization)	Mod.high to neutral	Second generation, high yields, high efficiency
Eucalypt	Grassland/woodland	Monocultures/ toxic agrochemicals in case of SCR	Mod.high to neutral	Second generation, high yields, high efficiency

- Monocultures require the inclusion of 'habitat islands' and/or 'migration corridors' to safeguard biodiversity.
- Biotechnology involves uncertainties regarding effects on agro-diversity. It allows for the use of specific herbicides, which may severely impact biodiversity.
- First-generation feedstocks (in particular maize and rape) require substantial fertilization and agro-chemicals for pest and disease control causing environmental impacts (eutrophication) which in turn may affect biodiversity.
- Some feedstocks are aggressive invasion species (in particular jatropha and reed canary grass).
- Monocultures of tall, long rotation feedstocks may significantly alter visual aspects and dynamics of agricultural landscapes - this is the case for second-generation feedstocks. Large tracts with monocultures of maize and sugar cane may have similar effects.
- Reed canary grass invades fragile wetland ecosystems. Willow grows well under (semi) wetland conditions.
- In particular short duration coppice rotation systems and short duration single stem rotations systems (mainly poplar) lead to infectious diseases, which in turn necessitates application of environmental unfriendly fungicides.
- Toxicity of the biofuel feedstocks may impact safe handling of the produce (jatropha) or its toxicity is effectively preventing undergrowth (eucalypt) and directly reducing biodiversity.
- Biotechnology and development of GMOs refer to mainly soybean, rape (canola), maize, poplar and sugar cane (and to some extent to switchgrass). Limited biotechnical developments apply to jatropha (not domesticated), cassava, reed canary grass, miscanthus, willow, and eucalypt.

The table above was retrieved from Fischer, G., Hizsnyik, E., Prieler, S., Shah, M., & van Velthuizen, H. (2009). *Biofuels and Food Security*. Vienna: Stiepan Druck GmbH, page 78.

Annex II

ANNUAL FOOD PRICE INDICES (2002-2004=100)

Date	Food Price Index	Meat Price Index	Dairy Price Index	Cereals Price Index	Oils Price Index	Sugar Price Index
1990	105.4	124.0	74.8	97.7	74.0	178.1
1991	103.6	125.4	79.6	97.1	79.1	127.2
1992	108.5	125.2	95.4	102.5	84.3	128.5
1993	104.6	118.1	84.6	99.5	86.0	142.2
1994	110.6	115.0	82.3	104.5	113.4	171.8
1995	123.2	118.4	109.6	119.3	125.0	188.5
1996	129.1	128.4	109.4	140.8	111.2	169.7
1997	118.5	123.2	105.1	112.4	112.5	161.4
1998	107.1	103.2	99.1	99.9	129.9	126.6
1999	92.4	97.8	86.3	90.6	91.6	89.0
2000	90.4	95.8	95.4	85.2	67.8	116.1
2001	93.4	96.5	107.1	86.5	67.6	122.6
2002	89.9	89.5	82.2	94.4	87.0	97.8
2003	97.7	96.8	95.1	98.1	100.8	100.6
2004	112.4	113.7	122.6	107.5	112.2	101.7
2005	117.3	120.1	135.4	103.5	103.6	140.3
2006	126.7	118.5	128.0	121.7	112.5	209.6
2007	158.7	125.1	212.4	166.9	170.0	143.0
2008	199.8	153.2	219.6	237.8	227.2	181.6
2009	156.9	132.9	141.6	173.7	150.9	257.3
2010	185.3	152.2	200.4	182.6	194.2	302.0
2011	227.6	176.6	220.5	246.8	252.3	368.9
2012	211.6	174.7	188.6	240.9	225.3	305.7

The information above was retrieved from the *Food Price Indices Data* document, available at the following website: http://www.fao.org/fileadmin/templates/worldfood/Reports_and_docs/Food_price_indices_data.xls