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The Steaks Are High (Up the Food Chain):

How Livestock Threatens Global Food Security

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Bratislava 2015 **Nikoleta Ficová**

Declaration of Originality

I hereby declare that this thesis and the work reported herein was composed by and originated entirely from me. Information derived from the published and unpublished work of others has been acknowledged in the text and references are given in the bibliography.

Bratislava, 30.4.2015 Nikoleta Ficová

Abstract

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The aim of this thesis is to provide an alternative view on dealing with the issues of global food security and climate change. It presents a case that the main focus should be on the livestock sector instead of the energy sector for two reasons. First, the extent of the livestock sector's contribution to climate change and its potential for mitigation is largely underestimated. Second, livestock production practices are unsustainable and put immense pressure on the, already scarce, natural resources. If these issues are left unaddressed, it will have negative consequences for the future of food security.

The structure of the thesis consists of three chapters. The first chapter deals with the concept of food security and explains how international cooperation is possible. The second chapter focuses on climate change mitigation where it provides a background on the international climate action, explains how the livestock sector contributes to climate change, explores some social issues arising from that, and finally reviews aspects of renewables that can be dangerous for future food security. The final chapter deals with the use of land and water in connection with food production. By outlining the livestock sector's mismanagement of these resources, this chapter shows the extent of the danger this sector poses to global food security.

The thesis concludes that the negative effects of animal agriculture are too extensive to be ignored. In order to efficiently fight climate change and at the same time ensure food security in the future, making this sector more sustainable needs to become a priority. In order to do that, policy makers and general public alike need to pay more attention to the above outlined problems and initiate change. Making the practices that this sector uses more sustainable will require a lot more research, education and discussion on regional, national and international levels.

Abstrakt

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Cieľom tejto práce je poskytnúť alternatívny pohľad na riešenie globálnych problémov potravinovej bezpečnosti a zmeny klímy. Práca prezentuje prípad, kde je potrebné zamerať sa predovšetkým na odvetvie živočíšnej výroby namiesto energetického sektora, a to z dvoch dôvodov. Po prvé, podiel živočíšneho sektora na zmene klímy a jeho potenciál v jej riešení je veľmi podceňovaný. Po druhé, výrobné postupy chovu dobytka sú neudržateľné a spôsobujú obrovský tlak na prírodné zdroje, ktoré sú už teraz ohrozené. Ak nepríde snaha o prehodnotenie týchto praktík, bude to mať negatívne dôsledky pre budúcnosť globálnej bezpečnosti potravín.

Štruktúra tejto práce sa skladá z troch kapitol. Prvá kapitola sa zaoberá konceptom bezpečnosti potravín a taktiež vysvetľuje ako je medzinárodná spolupráca možná. Druhá kapitola sa zameriava na medzinárodné snahy o zmiernenie zmeny klímy. Objasňuje históriu medzinárodných opatrení proti zmene klímy, vysvetľuje ako odvetvie živočíšnej výroby prispieva k zmene klímy, pripomína niektoré sociálne problémy ktoré z toho vyplývajú, a nakoniec skúma aspekty obnoviteľných zdrojov, ktoré môžu byť v budúcnosti nebezpečné pre potravinovú bezpečnosť, ako napríklad produkcia bio palív. Záverečná kapitola sa zaoberá využívaním pôdy a vody v súvislosti s výrobou potravín. Objasnením negatívnych dopadov živočíšneho sektora na tieto prírodné zdroje, táto kapitola ukazuje rozsah nebezpečenstva toto odvetvie predstavuje pre globálnu bezpečnosť potravín.

Práca dochádza k záveru, že negatívne účinky živočíšneho hospodárstva sú príliš rozsiahle aby boli ignorované. Aby bolo možné účinne bojovať proti zmene klímy a zároveň zabezpečiť bezpečnosť potravín v budúcnosti, je potrebné aby sa udržateľnosť tohto sektoru stala prioritou. Aby sa to stalo skutočnosťou, je potrebné aby svetoví lídri ako aj široká verejnosť, venovala viac pozornosti k vyššie uvedeným problémom a aby iniciovali zmenu. Na to aby sa výrobné praktiky tohto sektora stali udržateľné si bude vyžadovať oveľa viac výskumu, vzdelávania a diskusie na regionálnej, národnej i medzinárodnej úrovni.

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Introduction

To fully understand the world we live in today is simply not possible. No matter how much effort individuals may put into it, nobody will ever truly understand the causes and effects of our actions because globalization makes them too complex. Choosing an approach to deal with a problem is always difficult because one can never be certain it will work. In some cases, one can simply try again. However, policy makers dealing with global issues don't have that luxury and choosing a wrong path can have even life-threatening consequences. That is why it's crucial for them to keep an open mind and consider the issues we face and the approaches to solve them from all the possible angles. It is the purpose of this paper to provide such an angle; an alternative approach, which has been largely overlooked so far. The focus is to connect the livestock sector's environmental impacts, including climate change with the issue of global food security.

There is a number of studies who expose the negative effects of the livestock sector on the environment. The most extensive is the well-known report called The *Livestock's Long Shadow*, published by the Food and Agricultural Organization (FAO) of the United Nations. This publication serves as the basic source of facts for this thesis. However, the purpose here is to go further and connect the sector's impacts with the issue of global food security. So far, none or very few studies have focused on this aspect. Secondly, livestock sector's role in climate change has also been studied but it has rarely been presented as the potential source for mitigation. The FAO has made some effort to call attention to that possibility by publishing a more focused version of its previous report, this time called *Tackling climate change through Livestock*. However, results of both are currently still largely overlooked and the main attention for mitigation possibilities is on the industrial or energy sectors. The paper aims to point out that for best results this should be reversed or at least approached simultaneously.

Global food security presents one of the toughest challenges humanity has ever faced. We need to produce enough food for 9 billion people by 2050 in the face of

ever growing obstacles, namely climate change and environmental degradation. Both influence our ability to grow food which is why it is crucial to reverse them. The most challenging part is that food production itself is a significant contributor to these problems. In some cases, for example deforestation, it is even the main cause. Animal agriculture is the most environmentally demanding because, among other things such as pollution, its resource use and resource conversion is very inefficient. It takes much more resources, namely water, land and energy to produce one kilogram of animal product than its plant counterpart. So the goal is to grow enough food for a rapidly growing population which is eating increasingly higher up the food chain, while simultaneously decrease the environmental externalities. Livestock sector, while being a huge contributor to the problem, has equally large potential to be a part of the solution. It is simply a matter of choice.

In summary, this paper presents a view on dealing with the issues of global food security and climate change by focusing on the livestock sector instead of the energy sector for two reasons. First, livestock's contribution to climate change is so significant that its disregard on the mitigation agendas can undermine any progress made in the energy sector. Moreover, mitigation through this sector promises great potential and can be more effective than the energy sector because it would be cheaper and the results would show faster. Most importantly, climate change mitigation through the energy sector can improve "only" the environmental aspect, whereas the path through the livestock sector would also improve the social aspect, including food security of the most vulnerable. Second, the livestock sector poses a direct threat to global food security by its inefficient use of natural resources, namely land and water. In the view of their increasing scarcity, and the growth rate of crop yields declining, it is necessary to find and implement more sustainable alternatives of food production as soon as possible.

The structure of the thesis consists of three chapters. The first chapter deals with the concept of food security. Its aim is to provide background to the constant challenge of feeding the world's population, as well as introduce some issues associated with that. Working together on global problems, such as climate change and food security, requires a lot of dedication and effort from all the international actors. That

is why the second half of the first chapter delves deeper into the workings of the international system and explains how international cooperation is possible by using the theory constructivism. The second chapter focuses on climate change mitigation. Firstly, it provides a background on the international climate action, including a short analysis of the Kyoto Protocol. Then, it explains how the livestock sector contributes to climate change and explores some social issues arising from that. The last part explains that mitigation through the energy sector, namely increasing production of biofuels can endanger food security by adding additional competition for already scarce land and water resources. The final chapter deals with the use of land and water in connection with food production. By outlining the livestock sector's mismanagement of these resources, this chapter shows the extent of the danger this sector poses to global food security. The thesis concludes that the negative effects of animal agriculture are too extensive to be ignored. In order to efficiently fight climate change and at the same time ensure food security in the future, making this sector more sustainable needs to become a priority. In order to that, policy makers and general public alike need to pay more attention to the above outlined problems and initiate change. Making the practices that this sector uses more sustainable will require a lot more research, education and discussion on regional, national and international levels.

Chapter 1: Global Food Security

1.1. Does Food Matter?

Humanity has faced, is facing and surely will face an infinite amount of challenges during its existence on Earth. Some of them may be insignificant and some of them may be indeed grave. They will come and they will go. Only one challenge, however, will be present as long as we live, and that is the ability to feed ourselves. Without food, this basic commodity to sustain us, there will be no need to deal with any other issues because, obviously, we will be dead. So, no matter how pressing other issues that we face may seem, it is crucial that we always have in mind the importance of food security.

In most countries today, especially those who are economically well off, people seem to have forgotten all about what food means in a sense that food is taken very much for granted. People often do not know the processes behind food production and how it affects other members of the society or the environment. They do not question how the food they eat arrived on the shelf in their supermarket. After all, why should they. There is exorbitant amount of food products available to choose from. Just that simple fact can keep the consumers' minds occupied for days on end. When added to all the other troubles one faces on everyday basis, it is perfectly normal that one does not want to ponder even over meagre, basic, insignificant things, such as food. After all, it is always available is it not? Depending on one's income, the quality or choice may vary, of course, but in the wealthy countries, very little face starvation. Therefore, in those countries, food is often of not much concern to citizens. The goal here is not to criticize the consumers' lack of knowledge or their ignorance of the food production system. Not by far. They are, in many instances, the victims of that system. However, at the same time, consumers in the wealthy countries unknowingly contribute to the food insecurity of people in the poor countries. Our current era of globalization and technological advances has made food production process into a huge tangled web that even the experts may have trouble following. Food producers, especially huge transnational corporations,

have almost unlimited reign on the global market because there is no global government that has the authority to keep them in check. To clarify, the aim is not to criticize the expansion and the technological advances of food production that enables it to feed our constantly growing population. The problem arises when these producers start using the natural capital unsustainably, that is, to the point when its regeneration can no longer keep up and thus leaving it degraded, and eventually, even extinct. Hardin (1968) has discussed this phenomenon in his paper *The Tragedy of the Commons*, where he explained on the example of a "pasture open for all" that actions of rational individuals benefit their own interest but at the same time create negative consequences for the whole society. This idea is in direct opposition to Adam Smith's concept of the "invisible hand", which is still the most popular explanation of how the global market functions. The idea is that individual who seeks only his own interest is "led by an invisible hand to promote public interest" (Hardin, 1968). However, if the market is controlled by demand, or the wishes of the individuals, then it is difficult to establish who is to blame. The producers keep crossing the natural boundaries because of increased demand. The consumers, whose living standards keep rising, increase their demand without the knowledge of the global consequences. And around the blind circle goes. Environmental degradation is just an unfortunate externality of this process. That is why the individual countries have decided to create international institutions that would oversee and keep track of issues that are inherently of global consequence. For instance, it is obvious that environmental problems, such as climate change can't be contained within the borders of individual countries. Its mitigation should therefore be in everyone's interest. However, it is not so obvious that global food security should be in everyone's interest and it certainly was not on the international agenda until very recently. Let us therefore discover how this change has come about, what it stands for and what it might tell us about the future of humanity.

1.2. The Concept of Food Security

The beginnings of our concern with food security can be traced back to the global food crisis in the 1970's. Because of bad weather conditions in the major food – exporting countries, global food production in 1972 and 1974 rapidly declined. World stocks of wheat dropped from 50 million tons in 1971 to 27 million tons in 1973 (FAO, 2000). Combined with the energy crisis of 1973, this resulted in a sharp increase in price of food, petroleum and fertilizer. The poor countries suffered the most, especially Ethiopia and the Sahel region of Africa which were also afflicted with severe droughts at the same time. Between 50,000 to 100,000 people fell victim to the famine that followed. All these events led the United Nations (UN) to organize the World Food Conference in 1974, where food security was defined as:

> *"Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO, 2003).*

It can be seen that back then, the main and only concern was to produce enough food. However, that is only one of the aspects of food security as we understand it today. The 1996 World Food Summit adopted a more complex definition:

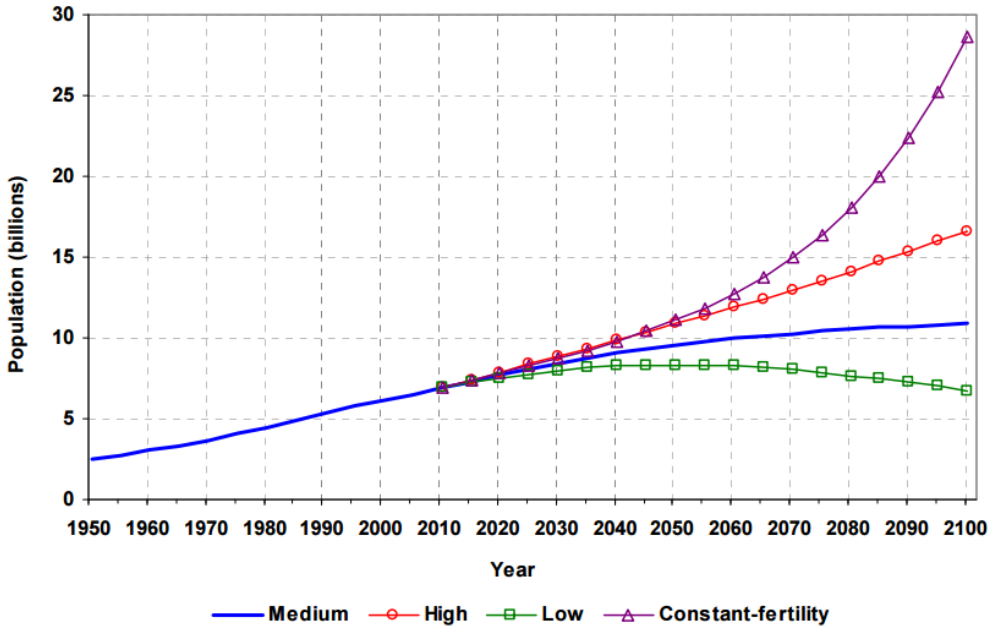
> *"Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 2003).*

Based on the second definition, food security is divided into four categories. First is food availability which controls whether there is physically enough food available, therefore it deals with food production. This is the aspect this thesis focuses on. Second category is food access, which oversees whether all households and individuals have adequate resources to either buy or produce their food. Third, food utilization deals with the nutritional aspect of food. And last, stability, which makes sure that all three conditions above are met (FAO, 2008).

The most obvious food security issue today is that people are still not safe from starvation. It belongs in the second dimension, food access. Humanitarian agencies report that there are around 850 million people suffering from hunger every day. While most of them live in developing countries, some are also in wealthy countries. The reason this problem exists is mainly due to distribution and adverse social, economic or political conditions, not because there is not enough food being produced. The fact, that almost 30% of food produced worldwide is wasted attests to that (Reisch, 2013). Furthermore, diet also plays a key role here. Meat rich diets, such as most OECD countries currently enjoy, put immense pressure on the environment. Not only that, when combined with the unfavorable socio-economic factors in the developing countries, they even largely contribute to their food insecurity. The reason for that is the inefficiency of grain-to-meat conversion. To produce 1kg of meat requires 7kg of feed for cattle, 6kg for pork, and 2kg for chicken and fish (Goodland, 1997). Goodland (1997) also claims that about half of the grain produced worldwide is used to feed livestock, which he considers as food wastage. International agencies trying to eliminate hunger largely deal only with the effects of this system, not its cause. That means, their focus is on improving the distribution of food. According to Godfray (2010), making sure that we eliminate hunger worldwide is only one of three challenges we face. The other two are to "match the rapidly changing demand for food from a larger and more affluent population to its supply and do so in ways that are environmentally and socially sustainable" (Godfray, 2010). So, a bigger challenge looms in the background, the challenge of feeding the constantly growing world population. Malthus was among the first who expressed concern over this issue. According to his theory, food production would not be able to keep up with the population growth because population growth was "exponential", or faster, than the "arithmetic" rate of food production. However, this was in the 18th century and since then numerous factors, which Malthus could not have predicted, helped to counteract his prognosis. Just to mention some, they include family planning, contraception, and most notably the Green Revolution during the 1960's. The period resulted in a dramatic increase in yields of agricultural production due to technological advancements. These factors helped on both fronts, to slow down population growth rate (in comparison to Malthus's prediction) and

increase the food production rate (Sachs). Figure 1 shows the most recent population growth projection released by the United Nations. According to the medium variant, global population should reach 9 billion by 2050.

Figure 1: Population growth from 1950-2100, according to different projections and variants



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2013). *World Population Prospects: The 2012 Revision.* New York: United Nations.

The challenge at hand, to feed 9 billion by 2050, is not whether we can produce enough food anymore, but whether we can do it sustainably. “Food production can be attained under current productivity and demand trends but not necessarily in ways that make progress in achieving environmental goals or social goals” (Herrero, 2013). So, the current food production can simply expand, the same as it has been doing so far. However, this will put such pressure on the environment that it will no longer be able to support us, and global food security will become critical instead of safe. So, in a sense this can be seen as an adapted Malthusian catastrophe because, in the end, we still face the threat of inadequate food supply. However, it is no longer because of insufficient food production but because of the unsustainable practices it uses. Water is another crucial variable that can be applied in his theory. We may produce enough food but what if we run out of water? Unsustainable practices that are used today, mainly in agriculture, significantly contribute to

world's water depletion and I will explain this in more detail in the last chapter. The question that still remains among many scientists is to what extent are we really unsustainable? Is the situation of the environment really so critical or is it heading in that direction? We have not reached a unanimous consensus yet. As Godfray (2010) explains, there are multiple views on the issue. On one hand, climate change and increasing competition for land and water resources push us to act fast. On the other hand, some believe that future generations will have more financial resources and better technology making them better equipped to make the change. In the end, there is also the fact that not enough research has been done to properly measure and evaluate sustainability strategies. One of the reasons may be due to the fact that study of international environment issues is relatively recent, most of it gaining recognition only in the late 1980's. It gained much larger political and intellectual importance following the UN Conference on Environment and Development in 1992 (Mitchell, 2007). It is worth exploring how such changes in thinking are possible on a global scale.

1.3. Faith in Humanity Restored: Theory behind Global Cooperation

"Anarchy is what states make of it" (Wendt, 1992).

The founder of the constructivist theory, Alexander Wendt, could not have formulated a more hopeful phrase when he described the nature of the international system. It means that the states are not inherently destined to struggle among themselves in order to ensure their survival in the harsh, self-centered world, as the rationalists would have us believe. On the contrary, they themselves decide how the relations among each other will be governed. It is entirely up to them whether they choose cooperation or war. It all stands on shared values, experiences and ideas. It is, of course, no easy task to come to agree on them but the important point is that the choice is there. No matter what challenges countries may face, they can choose to unite and tackle them together. Humanity has come a long way in order to get to this point. History shows us that our past is filled with more periods of conflict than

those of peace. Thankfully, majority of people have come to realize that they value the current era of relative peace above anything else. They have found their common goal, and that is to ensure a world free of warfare, and of general well-being. In order to achieve that, countries should strive to reach economic and political stability, and without being food secure, that would not be possible.

While the constructivist outlook may be hopeful for the future, it can also be a source of even more problems. It is precisely our values and morals that still tolerate the current socio-economic model thanks to which world food distribution is so uneven. The environmental aspect of the threat to food security is only just beginning to take force (climate change), but capitalism has been wreaking havoc for a long time now. In the constructivist sense, its threat to global food security is more imminent than that of climate change. If our values don't change, the environment will continue to deteriorate. However, to change people's values takes time, and one must first provide them with information. If they don't know the global consequences of food production, how can they be expected to put their values in it and call for change?

So, the key concept of constructivism, that is also applicable in the international environmental policy (IEP), is the complicated relationship between the structure and the agency. *"Human choices, over time, can transform 'normally invariant' structural forces...".* Furthermore, *"if structural forces make environmental degradation likely, they leave room for human actions that avoid it being inevitable. Policies cannot change carrying capacities but can shape demands on natural systems to better reflect them. Intergovernmental regulation or transnational civil society can create constraints and incentives to induce internalization of externalities. Over time, individuals and groups can consciously transform the values of global society to reflect environmental concerns" (Mitchell, 2007, p. 501).*

The extent to which we can influence the environmental policy is largely restricted by the structure of the international system. While this fact causes a lot of pessimism in the field of IEP, all is not lost. It has been shown that human agency has the capacity to make a significant difference in the system, if they choose to do so

(Mitchell, 2007). One way and perhaps the most effective way to do that is to set up international institutions.

International institutions are now a key player in dealing with global problems. It is hard to imagine how we could reach this level of interconnectedness, discussions and mutual cooperation on dealing with these issues without them. In fact, as Keohane (1988) put it, it's exactly „the combination of potential value of agreements and the difficulty of making them that renders international regimes significant". There are countless such institutions and organizations whose scope and influence vary significantly. Perhaps the largest both scope and influence can be attributed to the United Nations. It was established in 1945 after the end of the Second World War with a simple goal to ensure future peace. Today, with its 193 members each representing one nation, it is pushing for progress on virtually all fronts in our society, ranging from human rights to setting global development agenda. One of these goals is ensuring global food security and overcoming many issues associated with it, some of which are discussed in this paper. In broader context, it is a part of the post-2015 development agenda and the sustainable development goals (SDG's) which were agreed upon in 2012 at Rio+20, the United Nations Conference on Sustainable Development (UNEP, 2015). They are still under discussion but they build on the already existing Millennium Development Goals (MDG's) which expire this year.[1]

In summary, international actors and the international system in which they operate are mutually constitutive, in other words they influence each other. Creating international institutions helps to share mutual understanding and cooperation by providing information. They only do so much. The actual legislative changes and their implementation still remains in the hands of states. The UN's affiliated institutions, funds, and programs, called the „UN family" have a worldwide recognition and can influence even individual state policies. As will be discussed in the following chapter, international actors have already chosen a new direction, a direction moving the

[1] A full list of the SDG's being proposed can be found in Appendix 1.

world towards sustainability. Whether they have chosen the right tools to reach it is, however, under review.

Chapter 2: Livestock and Climate Change

Climate change has serious implications for the ability to produce food and thus plays an important part in the future of food security. The following sections review the current climate change mitigation efforts, outline the livestock sector's contribution to climate change, as well as explore the connections between livestock sector's environmental footprint, global food security and social implications. Mitigation limitations of the renewable energy sector and possibilities of the livestock sector are discussed in the last section.

2.1. Background on Climate Change Action

In the light of the seriousness of climate change and its complexity as a global issue, international actors decided to cooperate in finding a successful solution. The annual United Nations global climate conferences taking place in different world capitals began in 1992, at what is commonly known as The Earth Summit, in Brazil's Rio de Janeiro. The result of this summit was the first international environmental treaty, called The United Nations Framework Convention on Climate Change (UNFCC). Its main objective was for the member parties to create an agreement that would legally bind them to reduce their greenhouse gas (GHG) emissions, since they are the culprits behind our changing climate. The first (and only) such an agreement came into existence five years after the Earth Summit. It is called the Kyoto Protocol.

The Kyoto Protocol is currently considered to be the world's biggest achievement it terms of global cooperation on climate change mitigation. However, in its actual goal to decrease the global GHG emissions, it has been a failure for a number of reasons. Firstly, it targeted only the developed countries because, historically, they have been the biggest polluters and thus carry the biggest responsibility for the current GHG emission levels in the atmosphere. Morally, this might be acceptable, but practically it makes no sense. Currently, China is the largest GHG polluter, producing almost double the amount of the United States, who take the second place and, as it happens, did not even sign the Protocol. Also, other developing countries, such as

India, Brazil, Indonesia and Mexico are among the top ten polluters (EPI, 2014). So, in the end, even though most of the targeted countries reached their goals of reducing emissions below their 1990 levels, as was the agreement, the global GHG emission levels increased. The first stage of the protocol ended in 2012, so right now there is no international legally binding agreement in effect. The second commitment period of the Kyoto Protocol was proposed, also known as the Doha Amendment, but many countries have not ratified it, thus effectively dismissing it. There is a new internationally binding treaty in the making, which is supposed to be adopted this year at the 21st Conference of the Parties in Paris. Will it be any better than Kyoto? It is hard to say, but at least it's going to fix its first mistake and target both the developed and the developing countries. However, even if the countries manage to agree on something in Paris; and that is a big "if" for many reasons[2]; that still might not be sufficient to stop climate change. The next section reviews some of the reasons why that is the case.

2.2. Livestock's Contribution to Climate Change

The second crucial issue of the Kyoto Protocol, and, as it seems, of the impending Paris agreement, is that its focus is specific mainly to the GHG emissions produced by the industrial production, that is, by burning fossil fuels. This is highly problematic because, as the European Commission acknowledged, climate change is caused by three factors: burning fossil fuels, cutting down rainforests and farming livestock. In order to fight climate change successfully, it is necessary to address all its major contributors, namely the livestock sector, who is second in line in production of the GHG emissions, arguably, if not even the first.

According to the UN Food and Agriculture Organization (FAO), the livestock sector is responsible for 20% of the GHG emissions (2013). Another study by Goodland and

[2] The problem is to agree on what is fair. There are the developing countries, who in order to catch up with the rest of the world, in a cheapest way possible, burn mass quantities of fossil fuells. On the other hand, the developed countries being the ones responsible for the current emissions, should take the lead and make the the switch towards clean energy, but that is a very costly process. So both sides face obstacles that they need to resolve, and fast, in order to reach an agreement by 2015.

Anhang claims that it is in fact responsible for 51% (2009). The difference is indeed astounding, but a detailed analysis of both these claims should be left for another time. Suffice it to say, that even a median between the two makes animal agriculture a major contributor of climate issues. Let us, therefore, focus on something else: methane. Methane is currently the most dangerous greenhouse gas in the atmosphere. While most of the human-caused GHG emissions consist of carbon dioxide (64%), methane (17%) has 20 times the warming potential of carbon dioxide (UNFCCC, 1995). This should not be overlooked, given the fact that the largest global producer of methane is the livestock sector (GMI, 2010). It is produced as a by-product of enteric fermentation (digestive process) of the ruminant livestock (cattle, buffalo, sheep, and goat). Manure storage and processing also emit methane along with nitrous oxide which has an astounding 296 times the global warming potential of CO_2 (FAO, 2006). Feed production (including deforestation to make way for pastures), processing, transportation, and energy consumption, for example to produce fertilizers, use machinery, etc., cause massive carbon dioxide and nitrous oxide pollution. Figure 2 shows how the GHG emissions are distributed in the livestock production process. Land use and land-use change has the biggest part in the GHG emissions. As mentioned earlier, deforestation alone is among the top causes of climate change. Forests, along with oceans and land, act as "natural sinks" that store carbon dioxide. When the trees are chopped down, it is released into the atmosphere, thus adding to the pollution.

Figure 2: Greenhouse gas emissions along the livestock food chain

	Emissions (Gigatonnes)	Percentage of total livestock sector emissions
Land use and land use change	2.50	36
Feed production	0.40	7
Animal production	1.90	25
Manure management	2.20	31
Processing and transport	0.03	1

Source: Steinfeld *et al.* 2006

Given the extent of animal agriculture's GHG emission levels, which makes it a major contributor to climate change, it is necessary to look at what is, in turn, the impact of climate change on agriculture.

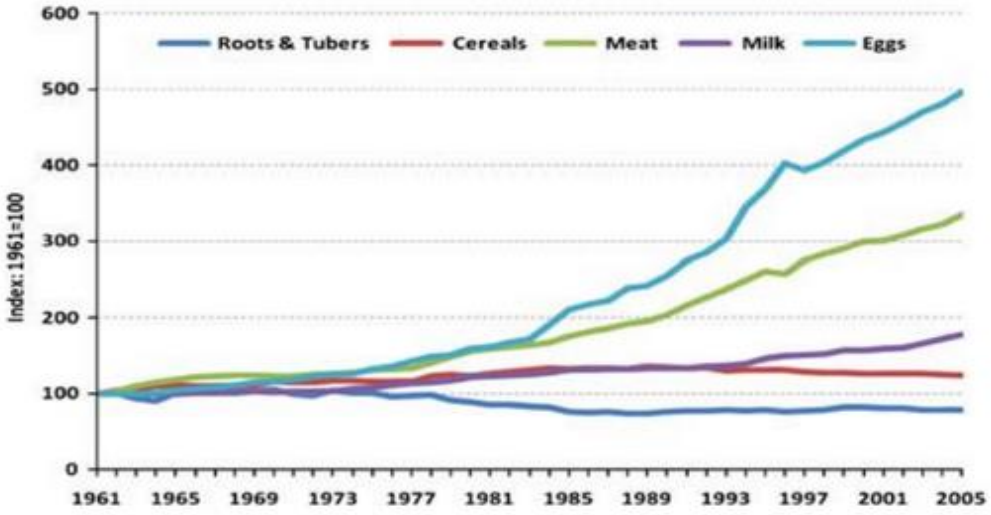
2.3 Livestock's Global Footprint

Climate change is already having dangerous impacts on the production of humanity's most important commodity, food. "It will depress agricultural yields in many regions, making it harder to meet the world's growing food needs" (World Bank, 2010). Even without climate change, rapid population growth and changing diets are already creating worries whether there will be enough food to feed us all. While for the developed countries, this is still a hypothetical question, poor countries are already feeling this pressure. Climate change threatens agriculture systems all over the world and there are two, preferably simultaneous options: to stop the climate change and/or adapt to the new conditions. Due to the worsening weather conditions, time is the key factor here. As I explained above, current mitigation efforts are costly and time consuming. Adaptation of the current agricultural systems also takes time and money. On the legislative level, this is a crucial step that policy makers need to take and start implementing. However, it doesn't mean that nothing can be done in the meantime. Individuals themselves hold the fastest and cheapest option to address climate change; by simply eating less meat and dairy products. By lowering demand, livestock production would lower and thus, instantaneously decrease its harmful emissions, especially in the form of the most dangerous GHG gasses, methane and nitrous oxide. As it is, the livestock sector is essentially tying a noose, not just around its own neck, but us all, and most people in the developed countries seem to be quite enjoying this blissful ignorance.

I say developed countries because for millions of people in poor countries, livestock is essential to their livelihood. Seré (2009) states that as much as 60% of these people depend on livestock. Paradoxically, it is not primarily for food, even though they face hunger on every day basis. Because the worsening weather conditions often threaten their crops, their only way to ensure their survival is to keep livestock as insurance, as well as means of saving money. In addition to that, livestock also provides them with manure to fertilize their crops and is used for pulling ploughs and transport goods to markets (Seré, 2009).

There is an argument that it is the developing countries causing the livestock sector growth, not the rich ones. Indeed, that is true. As they are rising out of poverty, by following the western model, their diet is becoming more meat intensive. As Figure 3 illustrates, there has been a rapid increase in their consumption of eggs and meat, followed by a milder increase in milk.

Figure 3: Per capita consumption of major food items in developing countries



Source: Opio, Gerber and Steinfeld (2011)

Mainly due to this trend, the livestock sector growth is projected to rise over 70% between 2005 and 2050 (FAO, 2013). Currently, however, people in wealthy countries consume 5 times more milk and meat than people in poor countries. These protein deficiencies contribute to their serious undernourishment and slow down cognitive development of children (Seré, 2009). That is why it is so crucial for people in wealthy countries to realize this fact and start doing their part in global social and climate action by adopting more sustainable practices and making responsible decisions, which could include shifting towards less meat intensive diets. According to some studies (Goodland, 1997; Reisch, 2013), changing diets towards less meat and dairy intensive can significantly reduce the pressure that food production puts on the environment.

As for the developing countries, there is another issue that needs attention in order for them decrease their agricultural GHG emissions. Their emissions “tend to be

relatively high because these animals subsist on poor diets that reduce efficiency with which they convert their feed into milk and meat" (Seré, 2009). Lack of technological advancement, insufficient finances or simply not enough knowledge are all contributing to their resource use inefficiency.

2.4. Social Connections

Since the very beginning of humanity, carnivory has been a natural part of our lives. In the hunter-gatherer societies, as the most important source of protein, it was a question of life and death. As we progressed, and the gap between the rich and the poor widened, eating meat increasingly became an affair for only the affluent. Consumers in the developed countries might not feel this anymore, but when we look at the global picture, this trend has prevailed. While some might think that the global picture does not matter; that over a billion people in the developing countries suffering from hunger and living in extreme poverty are just "unlucky"; they are terribly mistaken, or simply ignorant. Globalization has brought about economic conditions where actions of people in one part of the world directly affect the lives of people living across the globe. Same applies for agriculture, which is the main source of income in the developing countries. Food security of those less fortunate is at stake. The already happening changes in climate make their situation even more difficult and, even life-threatening. The saddest part of our demand-driven economy, is that half of the food produced and exported is used to feed the livestock, which consumers in the developed countries grew so accustomed to eating almost on daily basis. This trend will have to change, if we want to provide food security for the poorest and if we want the planet to sustain us for the generations to come.

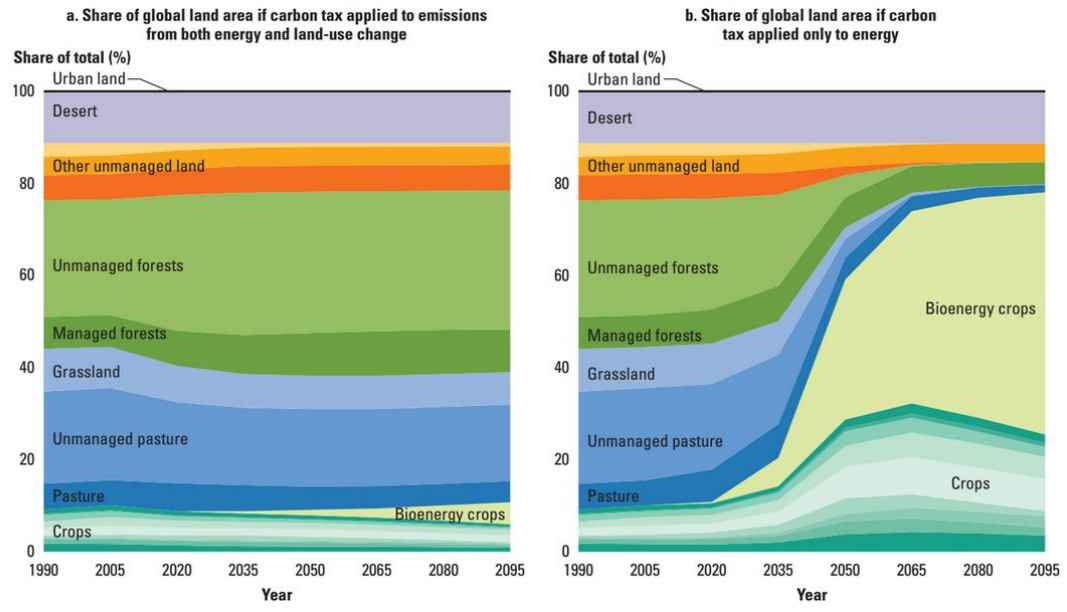
If we continue to do nothing and go about our business as usual, the poor will continue to starve, rainforests will perish, the deserts will spread and the earth temperature will become unbearable for life. All largely due to our unstoppable craving for meat. That is, of course, the worst case scenario, but the data collected so far support the opinion that it is not entirely impossible.

2.5. Livestock vs Renewables

The livestock sector is major contributor to climate change because of its significant greenhouse gas (GHG) emissions. Furthermore, due to rising living standards and thus rising demand for meat, there is another pressing challenge for climate change mitigation: the livestock sector is projected to grow; even double its current production and with it, consequently, its pressures on the environment (FAO, 2006). The possibly catastrophic consequences of climate change, such as global warming, rising sea levels, unpredictable weather, etc., have now been widely recognized and global action, both on national and international levels, is now underway in an effort to reverse or at least mitigate its effects. However, since it has been established by various major scientific bodies that the main cause of climate change is burning of fossil fuels, virtually all mitigation efforts are being focused on the industrial sector. This method already faces many obstacles for various reasons, the simplest of which are the high cost, and the amount of time it takes to switch from fossil fuels to renewable energy sources. A more important issue is that some types of renewables, like biofuels, may directly affect food security because they are another source of competition for land and water. If the biofuel production rapidly increases, global food prices will go up. World Bank (2010) reports that according to the current projections, the use of land for biofuel production should increase four times by 2030 and continue to move upwards. “Under some scenarios for mitigating climate change, projections beyond 2030 suggest that land allocated to producing biofuels by 2100 will grow to more than 2 billion hectares – a huge figure given that current cropland covers ‘only’ 1.6 billion hectares” (World Bank, 2010). Since biofuels are seen as a sustainable energy source, no carbon tax applies to them, yet. That is, however, highly problematic because, if the sector expands as projected, it will require additional land changes. As Figure 4 indicates, natural (unmanaged) forests and pasturelands will practically disappear. Given, that the actual contribution of biofuels towards reductiong of GHG is not clear, it is unwise to concentrate most of our attention towards that sector. On the other hand, the livestock sector shows great potential (World Bank, 2010).

In the view of the livestock sector's significance in contributing to climate change and the projected future growth of this industry, its complete disregard on the global mitigation agendas can have very dire consequences for the global food security. World Bank (2010) reports that, not only is the mitigation potential large, but agricultural techniques that help sequester carbon can increase crop yields as well. This is the reason why carbon sequestration in the agriculture sector can be a cheap and efficient way to mitigate climate change. "At $100 a ton of CO2, potential emission reductions from agriculture are on par with those from energy" (World Bank, 2010). Techniques for storing carbon in the soil vary from region to region depending on different types of soil and climate conditions and still require additional research. That is something that policy makers need to start focusing on. Additional options for climate change mitigation in the livestock sector include switching from ruminant to monogastric animals, better manure management, providing farmers with incentives to protect the environment and feed livestock better diets to reduce methane emissions (Seré, 2009). Regarding the last option, Godfray (2010) believes that biotechnology could help produce modified plants to feed the livestock, which would decrease methane emissions during their metabolic process.

Figure 4: A carbon tax applied to emissions from agriculture and land-use change would encourage protection of natural resources.



Source: World Bank (2010)

Chapter 3: Role of Land and Water Issues in Global Food Security

3.1. General Overview: Threats to Global Food Security

Earth's natural resources are finite. As Hardin showed on the example of a "pasture open to all", the socioeconomic model that is currently in effect does not acknowledge that fact however. The continuing mismanagement of the natural commons has created serious problems. The challenge to feed the 9 billion requires our commitment to rectify this situation. There are several issues associated with land and water use that pose a threat to global food security, especially for the poor and vulnerable. Their nature makes them quite complex and interdisciplinary but there are five categories we can focus on. First, and most important issue is land and water scarcity. It is caused by increasing competition for use of land and water resources by those areas that do not produce food. The competing areas include biofuel crop production, protected areas for biodiversity conservation, urban areas, energy and industrial uses, forestry, and livestock production. Second issue is the unsustainable use of land and water resources. This can be either because of inadequate capacity, such as policies, institutions, or insufficient awareness, or because of unsustainable practices. Multiple factors can be contribute to these, among which are insufficient incentives for adopting sustainable practices, population growth, bad access to the knowledge on sustainable options, poverty, or internal conflict. Most of these factors, along with poor access to markets, or limited national endowment in land and water can also lead to the third problem, which is low level of domestic crop production. Fourth issue affecting food security is inadequate international cooperation, such as difficulties reaching trans-boundary agreements for managing land and water resources and fifth is presented by external factors, such as high variation in global food commodity prices, climate change impacts on farming systems or impacts of natural disasters (FAO, 2015).

When looking back at the first issue of increasing competition for land and water resources by non-food services, it is interesting to see livestock production among those areas. There is no doubt that it produces food, but paradoxically, in the case of land and water use, it is counted among the threats to global food security. The following section explains the reasons why.

3.2. The State of Land and Water in Livestock Production

At first sight, livestock does not appear to be a food security issue since it is one of the sources of food. However, FAO's report (2006) says that: *"livestock emerges as one of the top two or three most significant contributors to the most serious environmental problems…".* Since the environment provides the base for our ability to grow food, it is obviously directly connected to food security. The UN is trying to point towards this issue and by telling us that it is aware of it. The livestock sector may not be as economically interesting as before the industrial revolution, but in some regions it has a quite high social value. According to FAO (2006), 1,3 billion people are employed in this sector and another billion depends on it for survival. Thus it is a topic worthy of examination. Today, at least in the popular culture, the cult of eating healthy is gaining the support of many (mostly young) people. One of the popular aspects of it is the reduction of meat consumption (Daily Mail, 2015). But it is only a new trend, generally in wealthy countries. Without seeing the global picture, it is very misleading. In fact *"Global production of meat is projected to more than double…" (FAO, 2006).*

Livestock is a major "player" when it comes to the issues of land and natural resources. People use to blame all kinds of industries for the loss of land and for the wasting of resources, but the truth is that the livestock sector is the *''single largest anthropogenic user of land" (FAO, 2006).* So it is not the crop growers, or oil companies, it is the industrialized and extensive animal production that is responsible for the large amounts of land being unable to produce anything else because *"…grazing still occupies and degrades vast areas of land" (FAO, 2006).* To make this assumption even scarier, FAO (2006) claims that livestock production is

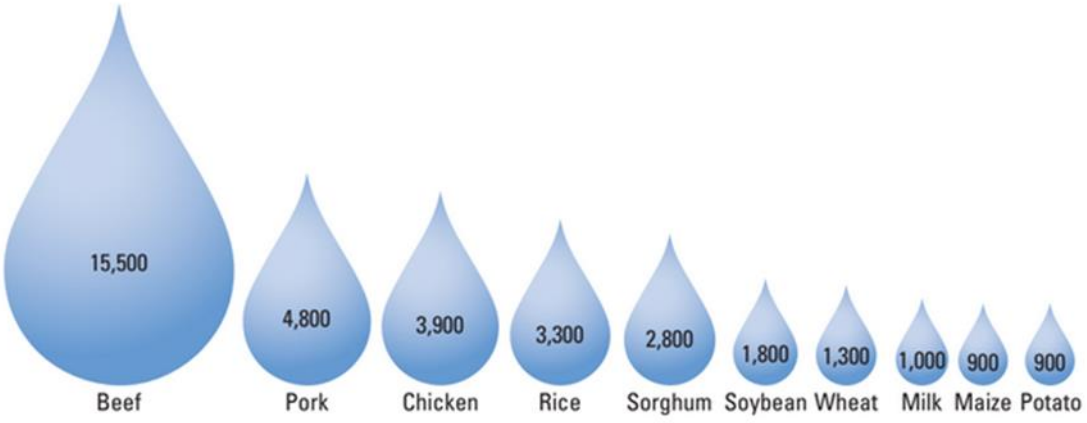
taking place on 30% of the land surface of the earth and 70% of all agricultural land. This means that the land that could be used for the crops to feed people, is used by the farmers to either rear animals, or to grow food for them. Even somebody who has no clue about this topic would agree that these are pretty significant numbers. If someone wants to rear animals he must prepare the land for them first. In some areas, it is not a problem, e.g. on the great plains in the USA, but in the areas such as the Amazon rainforest, the land must be changed. The FAO (2006) claims that 70% of the former rainforest in Latin America has been changed into land used for either pastures for the animals, or into fields to grow feed for them. But it is not the end for the land to be occupied by livestock. After some time, it becomes overgrazed, thus it cannot be used anymore, so the animals must move elsewhere. FAO claims that this land can be salvaged, but it is an expensive process (FAO, 2006). The International Food Policy research Institute (IFPRI), in their 2012 report, agree with the fact that the land becomes increasingly scarce because of substantial land degradation, in forms of desertification, desalination, deforestation and soil erosion. They also believe that this situation is not going to change in the foreseeable future, since the demand for non-food products is constantly rising and thus increasing competition for land (IFPRI, 2012).

The problem of deforestation has been mentioned, but it brings more problems than "just'' the loss of the trees. Forests are necessary for water regulation because of their ability to soak up and store water inside them. Thus they can help with reducing floods and droughts (IFPRI, 2012). It does not come as a surprise but water problems are (or should be) the environmental issues of today. According to FAO (2006), 64% of the world's population will have fresh water shortages by 2025. So this is a problem that is going to influence roughly two thirds of the world population, and yet there is still not much going on to solve it. FAO also claims that livestock is responsible for more than 8 percent of global human water use. And since they use so much freshwater, it makes sense, that FAO claims the major sources of pollution to be connected with the livestock industry.

One of the problems of industrialized livestock production with regards to water is its centralization. For the farmer, this makes complete sense since it is far easier to

manage vast numbers of animals on one smaller location, than the animals scattered across the larger area. The result of this, is that the animal produce waste, and other things, which eventually end up in the water, and since they live on a smaller area, the amount of polluted material that goes into the rivers and oceans is too big. The FAO sees here the opportunity to improve the current state of water pollution, when they say that: *"Industrial livestock production should be decentralized…" (FAO, 2006).* The same FAO report however suggests that the food production may be compromised by the increasing water consumption (FAO, 2006). In the end, people's need for water will always triumph the industries' need for it. But it does not mean that all the problems will solve by themselves. Water plays a huge role inside the whole ecosystem of the planet earth, so we bring it to its limits, not only food production and human consumption would suffer, but all the living things would be in danger. FAO thinks that the ''decision makers'' do not really understand the influence of livestock sector on the water resources. And I cannot but agree with them. In very dry regions, like Middle East and Northern Africa, as much as 90% of available water goes to agriculture (SDSN, 2013). In some countries, like Botswana for example, 23 percent of all the water consumed in the country goes to the livestock sector (FAO, 2006). The water we are talking about is not used only for the obvious purposes such as for the animals to drink, or for their food to be grown. *"At red meat abattoirs, water is used primarily for washing the carcasses at various stages and for cleaning'' (FAO, 2006).* This only illustrates the fact, that we do not even have the idea how much water is used by the livestock industry, and for what purposes. Still, the largest share on the water consumption in the livestock industry holds the food production (FAO, 2006). I do not mean the food for humans, but the one that is given to the animals. The FAO (2006) reports that 45% of all the water used for food production is used in livestock industry. Figure 5 illustrates the extent of the water use of meat production compared to grain production. Thus we see that livestock takes a huge part not only on the destruction of the land, but it is also largely responsible for the upcoming water problems.

Figure 5: Liters of water required to produce 1kg of product



Source: Waterfootprint (https://www.waterfootprint.org), accessed May 15, 2009; Gleick 2008.
Note: Figure shows liters of water needed to produce one kilogram of product (or one liter for milk). Water use for beef production only characterizes intensive production systems.

Source: World bank (2010)

3.3. Future Crop Yields and Land Use Trends

Availability of land for food production is at the center of concern for ensuring food security. As mentioned before, availability can be influenced by a myriad of factors ranging from competition among various sectors to the way it is used by those sectors. The agricultural sector is the biggest paradox and therefore presents the biggest challenge. Its goal to ensure food security is simultaneously being undermined by its unsustainable practices. With the current production trends, it seems that we are moving one step forward and two steps back. The step forward being the increased food production or the economic growth as such, and the two steps backwards are social and environmental. The problem is that those two steps back are not obvious. They can't be accounted for in the business plans, or in any "rational", economic calculations. Herein lies the problem. When leaders look for solutions to the problems we face, these three factors need to be on an equal standing, not at the expense of one another. In order to meet the growing food demands, agriculture needs to increase its production in the face of falling crop yields, while at the same decrease its negative externalities because they undermine its efforts. They are interconnected and solutions cannot be other than interdisciplinary.

Future projections regarding food production and land use trends indicate that agriculture will need to make major changes and adaptations. Most of these include increasing productivity by investing in and relocating to the developing regions. Overall land suitable for agriculture is not projected to grow in the future due to climate change. Potential land additions in the cooling areas will be offset by the losses in the warming climates, or vice versa depending on the crop requirements. This means that food production will need to increase on the land already in use. However, other sources say extensification is still expected to take place in Sub-Saharan Africa and Latin America, largely at the expense of natural habitats (FAO, 2015).

Godfray (2010) estimates that by 2050, food production will need to increase by 70% up to 100%. This presents a huge challenge because in addition to the already mentioned problems of land degradation, crop yields are decreasing. "The rate of increase in yields for key agricultural commodities has been declining since the 1960's" (World Bank, 2006, p.133). Climate change is intensifying this trend in many regions. Studies also report that most of the yield growth potential is in the developing countries because the world's major cereal exporters, like North America, are already reaching maximum yield potentials (World Bank, 2010). " Yield growth for cereals is expected to drop from an average of 1.96% per annum for the period 1980-2000 to 1.01% in 2000-2050, with even slower growth rates for developed countries" (UNEP, 2014). However, while the potential to increase food productivity lies in the developing countries, based on Cline's research their overall agricultural output potential will go down by up to 21% due to global warming (UNEP, 2014). What's more, "food production in the developing countries can be severely affected by market interventions in the developed world, such as subsidies or price supports" (Godfray, 2010).

In summary, the path to increased food productivity and consequently food security leads through the developing countries. However, so far theory is much different from reality. In reality, there are many obstacles standing in the way, whether they be agronomic, economic, or social (SDSN, 2013). Farmers in developing countries lack the technological knowledge and financial support to improve their farming

practices. That is creating large yield gaps between regions. Improving those practices will help reach farmers better efficiency and thus increase productivity without needing to use more land. "Bruinsma estimated that about 80 % of the projected growth in crop production in developing countries would come from intensification..." (FAO, 2015).

So, the ultimate goal seems to be intensification instead of extensification. But even that needs to be approached with care, especially in the context of animal agriculture. The next section discusses the issues of intensification and how we can move on from there.

3.4. The Way Forward: Sustainable Intensification?

The term "sustainable intensification" gained global recognition after it was used in an important publication, called *Reaping the Benefits* from the UK Royal Society where they defined it as food production where "yields are increased without adverse environmental impact and without the cultivation of more land" (Garnett & Godfray, 2013). According to Garnett & Godfray (2013), sustainable intensification is a controversial topic mostly due to the fact that for various people it means various things and there is no common understanding on what it actually encompasses or who might benefit most. One of the issues is that originally it was meant for crop production. When it's applied to livestock production, as is now called the intensive animal farming, it inherently means that animals will be under more stress than they already are. "Almost by definition, there will be an inevitable decline in animals' welfare" (Garnett & Godfray, 2013). Animal welfare is increasingly recognized as being important. Until these controversies are resolved, it is difficult to say how soon and in what extent sustainable intensification can help us in the future.

Traditional or current intensification techniques used in agriculture, mostly in the industrialized countries, create serious negative externalities. While this method saves the amount of land needed by having high efficiency, that is about all the benefits there are. Its negative effects vastly outweigh the benefits. Well, environmentally speaking, at least. If the developing countries simply follow this

model, without investing in research for more sustainable options, the trouble with food security will not be solved in the long-term. Therefore, the generally accepted solution to move forward lies in intensification that eliminates its negative side effects. In other words, intensification that is sustainable.

Intensive animal farming creates serious problems, such as land degradation and water pollution due to livestock waste and overuse of fertilizers for their feed. Global trade of meat and their feed increases the sector's environmental costs, including large quantities of GHG emissions. However, there are arguments that intensive animal farming actually helps mitigate climate change by its better feed to meat conversion efficiency. "While an individual more productive animal may generate more emissions than an individual less productive one in absolute terms, fewer animals are required to deliver a given amount of edible output, the overall effect being a reduction in emissions measured per given volume of output" (Garnett & Godfray, 2013). This, however, assumes that animal welfare would be at stake. Furthermore, intensive livestock production is a source of serious concerns regarding a creation and transmission of infectious pathogens, such as the H1N5 virus, also called the avian influenza or bird flu (SDSN, 2012).

If we are to follow the path of sustainable intensification, all these externalities would have to be significantly reduced and eventually eliminated. In the end, Garnett & Godfray believe that sustainable intensification is a feasible solution for future food production but it requires further research and discussion. So far, it seems that its techniques might not be appropriate in the livestock sector. However, there are other important options that show promise in decreasing the sector’s negative side effects, such as increased resource use efficiency, price adjustments to include full costs of the inputs, improvement of institutions and even people’s changes in diet. Goodland (1997) and Reisch (2013), in particular, believe that changing diets towards less meat and dairy intensive is key in reducing environmental pressures. Furthermore, in order for policy makers to start taking these options seriously, information, communication and education will be of utmost importance (FAO, 2006).

Conclusion

Global food production system has become too complex to fully understand. What is becoming clearer is that its practices are pushing the environmental boundaries to their limits. In the case of climate change, those limits have already been breached and the consequences are threatening the world's ability to produce food in the face of rapidly growing demand due to rising population and changing diets. These trends clearly indicate an urgent need to make food production more sustainable.

International community needs to put more attention on the agricultural sector, especially the animal agriculture, when trying to find solutions to global issues of climate change and hunger. Policy makers need to realize that these issues are inherently interconnected and even though the connections may not be very obvious, they need to find solutions that target all of them simultaneously. Focusing on just one sector, such as greenhouse gas emission reductions through the energy sector, does not solve the long-term problem of food security. On the other hand, making the livestock sector more sustainable will not only decrease the harmful emissions causing climate change but also contribute to solving larger environmental and social issues waiting in the background, namely the future of food security, not only in developed but also in developing countries. This would be possible through eliminating the pressure that the livestock sector puts on the environment, most significantly the climate and the natural resources, such as land and water, which is discussed in the paper.

Furthermore, the move towards sustainable alternatives needs to be acknowledged not only by the policy makers, but also the general public. Consumer choices have a large influence on the food production trends and thus have direct responsibility for the negative impacts of the industry. Since there is no global government who could enforce the elimination of the externalities, it is up to the public to initiate the change.

To conclude, cooperation to solve global problems must be interdisciplinary, instead of fractured into individual sectors. Moreover, it requires attention from both

leaders and general public alike. In the words of Amartya Sen: "There is a need to move ahead on different fronts simultaneously to eradicate hunger in the modern world. The public is not only the beneficiary of that eradication, but in an important sense, it also has to be its primary instrument. The first step is to see the public as the active agent rather than merely as the long-suffering patient" (Rogers, 2008).

Resumé

Prvotným nápadom pre túto prácu bola téma trvalo udržateľného rozvoja. Na prvý pohľad sa mnohým ľuďom môže zdať, že sa táto téma zaoberá len problémami týkajúcimi sa životného prostredia. V skutočnosti má ale o mnoho širší záber, pokrývajúci nielen aspekty environmentálne, ale aj hospodárske a sociálne. Poukazuje to na fakt, že takmer všetky globálne problémy ktorým dnes čelíme si vyžadujú interdisciplinárne riešenia. Táto skutočnosť ma doviedla k myšlienke pristúpiť k závažnému problému globálnej potravinovej bezpečnosti s novým uhlom pohľadu, ktorý spája viaceré disciplíny, prípadne pretvára ich na možné spôsoby riešenia. Účelom tejto práce je teda poukázať na dôležitú spojitosť medzi problémami globálnej potravinovej bezpečnosti, zmeny klímy a živočíšnou výrobou a hlavne jej kritickú úlohu v ich riešení.

Existuje rad štúdií, ktoré opisujú negatívne vplyvy odvetvia živočíšnej výroby na životné prostredie. Najrozsiahlejšou z nich je svetovo známa publikácia od Organizácie OSN pre Výživu a Poľnohospodárstvo (FAO), s názvom *The Livestock´s Long Shadow* (Dlhý tieň živočíšnej výroby). Táto publikácia je základným zdrojom faktov pre túto prácu. Avšak, jej cieľom nie je iba opisovať ale aj spojiť vplyv tohto sektora s problematikou globálnej bezpečnosti potravín. Dosiaľ existuje len veľmi málo štúdií s týmto cieľom, čo bohužiaľ neodzrkadľuje naliehavosť tejto témy. Ďalším aspektom je úloha ktorú hrá živočíšny sektor v zmene klímy. Hoci je už tento aspekt predmetom výskumu, len zriedka prezentuje tento sektor ako potenciálny zdroj pre jej zmiernenie. FAO preukázalo snahu upozorniť na túto možnosť zverejnením novej verzie svojej predchádzajúcej správy, tentoraz s názvom *Tackling Climate Change through Livestock* (Boj proti zmene klímy prostredníctvom živočíšneho sektoru). Avšak, výsledky oboch publikácií sú v súčasnej dobe ešte stále do značnej miery prehliadané a hlavná pozornosť sa pri boji so zmenou klímy kladie na priemyselné alebo energetické odvetvie. Cieľom tohto príspevku je poukázať na to, že pre dosiahnutie lepších výsledkov v boji so zmenou klímy a taktiež pre zaistenie globálnej potravinovej bezpečnosti, by sa tieto trendy mali vymeniť alebo by sa im aspoň mala prikladať rovnaká dôležitosť.

Globálna potravinová bezpečnosť predstavuje pre ľudstvo jeden z najťažších problémov. Do roku 2050 musíme vyrobiť dostatok potravín pre 9 miliárd ľudí, tvárou v tvár stále rastúcim prekážkam, a to, zmene klímy a zhoršujúcemu sa životnému prostrediu. Keďže oba problémy ovplyvňujú našu schopnosť potravinovej produkcie, je nevyhnutné aby ich riešiť čo najrýchlejšie a najefektívnejšie. Najproblematickejšie a zároveň najparadoxnejšie na tom je, že produkcia potravín sa sama o sebe významne prispieva k ich zhoršovaniu. . V niektorých prípadoch je dokonca hlavným dôvodom problému, ako napríklad pri odlesňovaní z dôvodu tvorby pasienkov. Živočíšna výroba je ekologicky nesmierne náročná, pretože, okrem iného, ako je znečisťovanie, používa a konvertuje prírodné zdroje veľmi neefektívne. Výroba jedného kilogramu produktu živočíšneho pôvodu si vyžaduje oveľa viac vody, pôdy a energie než výroba rovnakého množstva produktu rastlinného pôvodu.

Táto práca prináša alternatívny pohľad na riešenie otázok globálnej potravinovej bezpečnosti a zmeny klímy a to tým že sa v ich riešení zameriava na sektor živočíšnej výroby z dvoch dôvodov. Po prvé, podiel živočíšneho sektoru na zmenu klímy je natoľko významný, že jeho ignorovanie pri snahách zastaviť ju môže narušiť akýkoľvek pokrok dosiahnutý v energetickom sektore. Okrem toho, živočíšny sektor ukazuje veľký potenciál v riešení tohto problému a môže byť účinnejší ako odvetvie energetiky, pretože by to bolo lacnejšie a výsledky sa ukázali rýchlejšie. A čo je najdôležitejšie, boj proti zmene podnebia prostredníctvom odvetvia energetiky môže zlepšiť "len" životné prostredie, zatiaľ čo riešenie prostredníctvom odvetvia živočíšnej výroby by zlepšilo aj sociálne aspekty problému, vrátane zaistenia bezpečnosti potravín tých najzraniteľnejších. Po druhé, chov hospodárskych zvierat predstavuje priamu hrozbu pre globálnu potravinovú bezpečnosť kvôli jeho neefektívnemu využívaniu prírodných zdrojov, najmä pôdy a vody. Pri pohľade na ich rastúcu degradáciu, a klesajúcemu rastu výnosov plodín, je nutné čo najskôr nájsť a implementovať viac trvalo udržateľných alternatív produkcie potravín.

Štruktúra práce sa skladá z troch kapitol. Prvá kapitola sa zaoberá konceptom bezpečnosti potravín. Jej cieľom je uviesť do povedomia pozadie stálej výzvy, ktorou je kŕmenie svetovej populácie, rovnako ako vysvetliť niektoré problémy s tým spojené. Spolupráca na globálnych problémoch, ako sú zmena klímy a bezpečnosť

potravín si vyžaduje veľa odhodlania a úsilia od všetkých medzinárodných aktérov. Preto sa druhá polovica prvej kapitoly vnára hlbšie do fungovania medzinárodného systému, a vysvetľuje, ako je medzinárodná spolupráca možná, za pomoci teórie konštruktivizmu. Druhá kapitola sa zameriava na boj proti zmeny klímy. Po prvé, objasňuje históriu medzinárodných opatrení proti zmene klímy, vrátane krátkej analýzy Kjótskeho protokolu. Ďalej vysvetľuje ako odvetvie živočíšnej výroby prispieva k zmene klímy, a pripomína niektoré sociálne problémy ktoré z toho vyplývajú. Posledná časť vysvetľuje, že boj prostredníctvom odvetvia energetiky, a to zvýšením produkcie bio palív, môže ohroziť bezpečnosť potravín tým, že zvyšuje konkurenciu o pôdu a vodné zdroje. Záverečná kapitola sa zaoberá využívaním pôdy a vody v súvislosti s výrobou potravín. Objasnením negatívnych dopadov živočíšneho sektora, táto kapitola ukazuje rozsah nebezpečenstva toto odvetvie predstavuje pre globálnu bezpečnosť potravín.

Našou neľahkou úlohou je teda vypestovať dostatok potravín pre rýchlo rastúcu populáciu, ktorá sa stravuje stále vyššie na potravinovom reťazci, a zároveň znížiť externality v oblasti životného prostredia. Chov hospodárskych zvierat síce vo veľkej miere túto úlohu sťažuje, no má rovnako veľký potenciál stať sa súčasťou jej riešenia. Je to len otázkou voľby.

Práca dochádza k záveru, že negatívne účinky živočíšneho hospodárstva sú príliš rozsiahle aby boli ignorované. Aby bolo možné účinne bojovať proti zmene klímy a zároveň zabezpečiť bezpečnosť potravín v budúcnosti, je potrebné aby sa udržateľnosť tohto sektoru stala prioritou. Aby sa to stalo skutočnosťou, je potrebné aby svetoví lídri ako aj široká verejnosť, venovala viac pozornosti k vyššie uvedeným problémom a aby iniciovali zmenu. Na to aby sa výrobné praktiky tohto sektora stali udržateľné si bude vyžadovať oveľa viac výskumu, vzdelávania a diskusie na regionálnej, národnej i medzinárodnej úrovni.

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Appendix 1: Sustainable Development Goals and Targets proposed by the Sustainable Development Solutions Network

Goals and Targets are for 2030 unless otherwise noted. Targets marked with (*) need to be specified at country or sub-national level. Each target will require one or more indicators to be developed at a later stage.

PREAMBLE[bb]

The Sustainable Development Goals (SDGs) build on the success of the Millennium Development Goals (MDGs) and aim to finish the job of ending extreme poverty in all its forms. The SDGs reaffirm the need to achieve sustainable development by promoting economic development, social inclusion, environmental sustainability, and good governance including peace and security. These goals reaffirm human rights and underscore the right to development as central objectives. They are universal and apply to all countries, national and local governments, businesses, and civil society. Sustainable development will require that the goals be pursued in combination, rather than individually or one at a time.

GOAL 1: END EXTREME POVERTY INCLUDING HUNGER[cc]

End extreme poverty in all its forms (MDGs 1-7), including hunger, child stunting, malnutrition, and food insecurity. Support highly vulnerable countries.

- Target 1a. End absolute income poverty ($1.25 or less per day) and hunger, including achieving food security and appropriate nutrition, and ending child stunting (MDG 1).
- Target 1b. [Other suitably revised targets of MDGs 2-7 included here or below.]
- Target 1c. Provide enhanced support for highly vulnerable states and Least Developed Countries, to address the structural challenges facing those countries, including violence and conflict.*

GOAL 2: ACHIEVE DEVELOPMENT WITHIN PLANETARY BOUNDARIES

All countries have a right to development that respects planetary boundaries, ensures sustainable production and consumption patterns, and helps to stabilize the global population by mid-century.

- Target 2a. Each country reaches at least the next income level as defined by the World Bank.[dd]
- Target 2b. Countries report on their contribution to planetary boundaries and incorporate them, together with other environmental and social indicators, into expanded GDP measures and national accounts.*
- Target 2c. Rapid voluntary reduction of fertility through the realization of sexual and reproductive health rights in countries with total fertility rates above [3] children per woman and a

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[bb] Preamble based on the Rio+20 outcome document.

[cc] The term hunger as used here embraces various things, including child stunting, food insecurity, and malnutrition. Appropriate indicators will need to be chosen to reflect the full spectrum of what constitutes hunger.

[dd] E.g. Low-Income Countries become at least Lower-Middle-Income Countries.

continuation of voluntary fertility reductions in countries where total fertility rates are above replacement level.*

GOAL 3: ENSURE EFFECTIVE LEARNING FOR ALL CHILDREN AND YOUTH FOR LIFE AND LIVELIHOOD

All girls and boys complete affordable and high-quality early childhood development programs, and primary and secondary education to prepare them for the challenges of modern life and decent livelihoods. All youth and adults have access to continuous lifelong learning to acquire functional literacy, numeracy, and skills to earn a living through decent employment or self-employment.

Target 3c. All girls and boys have equal access to quality early childhood development (ECD) programs.

Target 3d. All girls and boys receive quality primary and secondary education that focuses on learning outcomes and on reducing the dropout rate to zero.

Target 3e. Youth unemployment rate is below [10] percent.

GOAL 4: ACHIEVE GENDER EQUALITY, SOCIAL INCLUSION, AND HUMAN RIGHTS FOR ALL

Ensure gender equality, human rights, the rule of law, and universal access to public services. Reduce relative poverty and other inequalities that cause social exclusion. Prevent and eliminate violence and exploitation, especially for women and children.

Target 4b. Monitor and end discrimination and inequalities in public service delivery, the rule of law, access to justice, and participation in political and economic life on the basis of gender, ethnicity, religion, disability, national origin, and social or other status.

Target 4c. Reduce by half the proportion of households with incomes less than half of the national median income (relative poverty).

Target 4d. Prevent and eliminate violence against individuals, especially women and children.*

GOAL 5: ACHIEVE HEALTH AND WELLBEING AT ALL AGES

Achieve universal health coverage at every stage of life, with particular emphasis on primary health services, including reproductive health, to ensure that all people receive quality health services without suffering financial hardship. All countries promote policies to help individuals make healthy and sustainable decisions regarding diet, physical activity, and other individual or social dimensions of health.

Target 5a. Ensure universal access to primary healthcare that includes sexual and reproductive healthcare, family planning, routine immunizations, and the prevention and treatment of communicable and non-communicable diseases.[ee]

Target 5b. End preventable deaths by reducing child mortality to [20] or fewer deaths per 1000 births, maternal mortality to [40] or fewer deaths per 100,000 live births, and mortality under 70 years of age from non-communicable diseases by at least 30 percent compared with the level in 2015.[ff]

[ee] We recommend that countries retain suitably updated MDG indicators for HIV/AIDS, TB and malaria.

[ff] Countries that have achieved the mortality targets should set more ambitious aggregate targets that are commensurate with their development and ensure that the minimum quantitative targets are achieved for every sub-population.

Target 5c. Promote healthy diets and physical activity, discourage unhealthy behaviors, such as smoking and excessive alcohol intake, and track subjective wellbeing and social capital.*

GOAL 6: IMPROVE AGRICULTURE SYSTEMS AND RAISE RURAL PROSPERITY

Improve farming practices, rural infrastructure, and access to resources for food production to increase the productivity of agriculture, livestock, and fisheries, raise smallholder incomes, reduce environmental impacts, promote rural prosperity, and ensure resilience to climate change.

Target 6a. Ensure sustainable food production systems with high yields and high efficiency of water, soil nutrients, and energy, supporting nutritious diets with low food losses and waste.*

Target 6b. Halt forest and wetland conversion to agriculture, protect soil and land resources, and ensure that farming systems are resilient to climate change and disasters.*

Target 6c. Ensure universal access in rural areas to basic resources and infrastructure services (land, water, sanitation, modern energy, transport, mobile and broadband communication, agricultural inputs, and advisory services).

GOAL 7: EMPOWER INCLUSIVE, PRODUCTIVE, AND RESILIENT CITIES

Make all cities socially inclusive, economically productive, environmentally sustainable, secure, and resilient to climate change and other risks. Develop participatory, accountable, and effective city governance to support rapid and equitable urban transformation.

Target 7a. End extreme urban poverty, expand employment and productivity, and raise living standards, especially in slums.*

Target 7b. Ensure universal access to a secure and affordable built environment and basic urban services including housing; water, sanitation and waste management; low-carbon energy and transport; and mobile and broadband communication.

Target 7c. Ensure safe air and water quality for all, and integrate reductions in greenhouse gas emissions, efficient land and resource use, and climate and disaster resilience into investments and standards.*

GOAL 8: CURB HUMAN-INDUCED CLIMATE CHANGE AND ENSURE SUSTAINABLE ENERGY

Curb greenhouse gas emissions from energy, industry, agriculture, the built environment, and land-use change to ensure a peak of global CO_2 emissions by 2020 and to head off the rapidly growing dangers of climate change.[88] Promote sustainable energy for all.

Target 8a. Decarbonize the energy system, ensure clean energy for all, and improve energy efficiency, with targets for 2020, 2030, and 2050.*

Target 8b. Reduce non-energy-related emissions of greenhouse gases through improved practices in agriculture, forestry, waste management, and industry.*

Target 8c. Adopt incentives, including pricing greenhouse gas emissions, to curb climate change and promote technology transfer to developing countries.*

[88] The Fourth Assessment Report of the IPCC (2007) has defined this level as global average temperatures that are 2°C above the pre-industrial level. Recent scientific evidence suggests the need to reduce the long-term temperature increase to 1.5°C or less. The global emission reduction target should be regularly updated in view of the growing body of scientific evidence.

GOAL 9: SECURE ECOSYSTEM SERVICES AND BIODIVERSITY, AND ENSURE GOOD MANAGEMENT OF WATER AND OTHER NATURAL RESOURCES

Biodiversity, marine and terrestrial ecosystems of local, regional, and global significance are inventoried, managed, and monitored to ensure the continuation of resilient and adaptive life support systems and to support sustainable development.[hh] Water and other natural resources are managed sustainably and transparently to support inclusive economic and human development.

Target 9a. Ensure resilient and productive ecosystems by adopting policies and legislation that address drivers of ecosystem degradation, and requiring individuals, businesses and governments to pay the social cost of pollution and use of environmental services.*

Target 9b. Participate in and support regional and global arrangements to inventory, monitor, and protect biomes and environmental commons of regional and global significance and curb trans-boundary environmental harms, with robust systems in place no later than 2020.

Target 9c. All governments and businesses commit to the sustainable, integrated, and transparent management of water, agricultural land, forests, fisheries, mining, and hydrocarbon resources to support inclusive economic development and the achievement of all SDGs.*

GOAL 10: TRANSFORM GOVERNANCE FOR SUSTAINABLE DEVELOPMENT

The public sector, business, and other stakeholders commit to good governance, including transparency, accountability, access to information, participation, an end to tax and secrecy havens, and efforts to stamp out corruption. The international rules governing international finance, trade, corporate reporting, technology, and intellectual property are made consistent with achieving the SDGs. The financing of poverty reduction and global public goods including efforts to head off climate change are strengthened and based on a graduated set of global rights and responsibilities.

Target 10a. Governments (national and local) and business commit to the SDGs, transparent monitoring, and annual reports - including independent evaluation of integrated reporting for all major companies starting no later than 2020.*

Target 10b. Adequate domestic and international public finance for ending extreme poverty, providing global public goods, capacity building, and transferring technologies, including 0.7 percent of GNI in ODA for all high-income countries, and an additional $100 billion per year in official climate financing by 2020.

Target 10c. Rules for international trade, finance, taxation, business accounting, and intellectual property are reformed to be consistent with and support achieving the SDGs.

[hh] In line with the Aichi Biodiversity targets to be achieved by 2020.

Source: SDSN. (2013). *Solutions for sustainable agriculture and food systems.* Retrieved December 14, 2014, from The Sustainable Development Solutions Network, A Global Initiative for the United Nations: http://unsdsn.org/wp-content/uploads/2014/02/130919-TG07-Agriculture-Report-WEB.pdf