

# **Climatic Change, Land Use and Food Security in Uganda: A Survey of Western Uganda**

**Arthur Nuwagaba<sup>1</sup> and Lydia Kisekka Namateefu<sup>2</sup>**

## **Abstract**

The paper sought to shade light on the causes of climatic change, to what extent land use has contributed to climatic change and how this will impact on food security.

Global warming is likely to reduce agricultural production and increase food insecurity in the Tropics. Of recent in Uganda, deforestation, combustion of fossil fuels, and production of agricultural commodities such as rice and livestock have caused atmospheric concentrations of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases to rise significantly. “Greenhouse” gases absorb energy radiated from Earth to space and warm the atmosphere.

The paper sought to research on the causes of climatic change that seem to be both “man-made and natural, the impact of climatic change on food security and find out policy actions that could be undertaken to reduce on Climatic change. Evidence in Uganda (According to National Environmental Management Authority) show that the rate at which the climate is changing in Uganda is alarming.

The research study was empirical as the researchers used first hand information from the various stake holders. Data was obtained through interviewing, observation and reviewing of relevant literature.

Findings of the study are that human factors have contributed significantly to climate change. These manmade contributions can be seen in aspects of Deforestation, land degradation, increased industrialization, un controlled population and the need to tap gravity water. All these have contributed to food insecurity.

## **1 Introduction**

Uganda already experiencing the negative effects of climate change and the situation is expected to worsen as impending calamities will affect agriculture, infrastructure and health, the 2009 State of Uganda Population Report predicts. This will affect the country’s development efforts and cause shifts in the spread of diseases like typhoid, dysentery and

---

<sup>1</sup>Lecturer-Uganda Christian University

<sup>2</sup>Lecturer- Makerere University Business School

malaria. It will also lead to soil erosion, land degradation and damage the infrastructure. “This situation compromises the country’s ability to meet its own development objectives and the Millennium Development Goals,” the report says.

The Rwenzori region in western Uganda will see reduced rainy seasons, which will affect crops like beans. In addition, the ice caps on the Rwenzori Mountains have receded by 40% in the last half century, which will reduce the water flows into River Semliki.

*The paper sought to document the causes of climate change in western Uganda, the extent to which land use has contributed to climate change and how this phenomenon of climate change will impact on food security.*

## 2 Background of Western Uganda.

Western Uganda receives approximately 1,500 mm of rainfall a year and there are two distinct rainy seasons: April - June and October - December. The hottest months are between December and February, with an average daily temperature in Western Uganda of 29 °C. It has two big natural forests, Karinzu in Bushenyi District and Imaramagmbo. This region has a variety of lakes that include, lake katwe in Kasese, lake bunyonyi in Kabale, lake Nakivale in Isingiro (formerly in Mbarara, lake Kaceera in Kiruhura district, lake George and Albert in Kasese and other small lakes. The region has one of the longest rivers in Uganda-river Rwizi.(NEMA). This river serves is a source of livelihood for both humans and animals in the districts of Mbarara, Isingiro, Kiruhura and Lyantonde as it serves these districts with water.

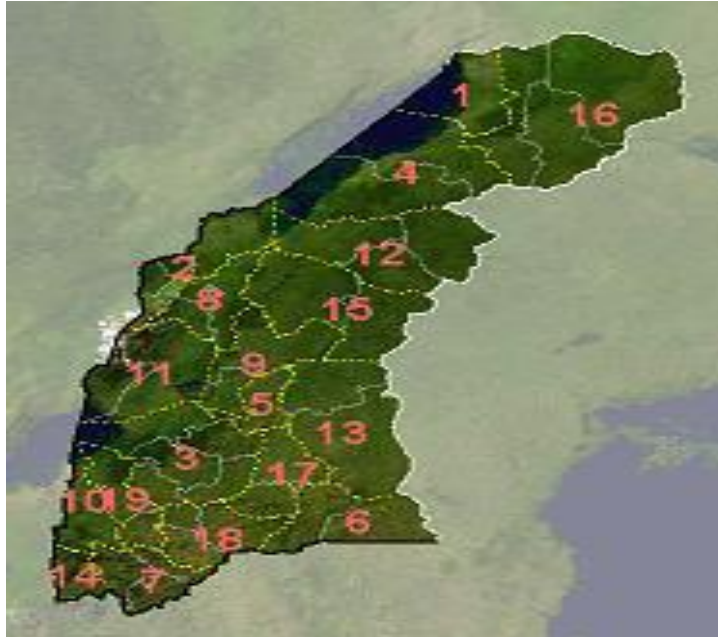


Figure 1: Map of Western Uganda: 1.Buliisa, 2.Bundibugyo, 3.Bushenyi, 4.Hoima, 5.Ibanda, 6.Isingiro, 7.Kabale, 8.Kabarole, 9.Kamwenge, 10.Kanungu, 11.Kasese, 12.Kibaale, 13.Kiruhura, 14.Kisoro, 15.Kyenjojo, 16.Masindi, 17.Mbarara, 18.Ntungamo, 19.Rukungiri

### 3 Methodology

The paper relied on empirical data. Data was collected through observation and interviewing. In some cases secondary data was used where literature was reviewed to see what other scholars have written as regards the subject under study. The research observed some phenomenon that relate to the variables in the subject under study. Things like land use as regards the grazing practices, planting patterns, construction, sand extraction grass burning and tree cutting were observed.

As regards interviewing, the researchers interviewed some officials from the National Environment Management authority (NEMA) a body responsible for overseeing environment protection from some districts in western Uganda. Some elders and prominent farmers in some selected districts were also interviewed to give their views on whether they think that there is climate change, what could be some of the causes and how this could impact on food security.

#### 3.1 The Concept of Climate and Climate Change

Climate is the prevailing or average weather conditions of a place as determined by the temperature and metrological change over a period of time. Various factors determine climate and the most important are rainfall and temperature (NAPA, 2007)

**Climate change** is any long-term change in the statistics of weather over periods of time that range from decades to millions of years. (IPCC, 2001a). It can express itself as a change in the mean weather conditions, the probability of extreme conditions, or in any other part of the statistical distribution of weather. Climate change may occur in a specific region, or across the whole Earth.

##### **Some facts about climate change:**

- Average global temperatures are rising, making the 21st century the warmest, the world has ever seen in 1,000 years, since the 1980s were the warmest decades on record;
- Climate change and the threat of related extreme conditions like flood and droughts have major implications for development particularly in poor countries like Uganda;
- Already, Districts like Bushenyi, Mbarara, Isingiro, Ibanda and Kasese have borne the effects of climate with clear changes in precipitation (rainfall), water availability, length of seasons, incidents of extreme weather patterns, floods, desertification, distribution and prevalence of pests and diseases;
- Areas like Kabale that used to have cold weather are now warming up which has increased incidences of malaria than previously reported
- At global level, about 40% of all the carbon emitted by human activity has come from cutting forests and increased industrialisation. Stopping deforestation is, in principle, cheap and simple;
- Livestock and livestock-related activities such as deforestation and increasingly fuel intensive farming practices are responsible for over 18% of human-made greenhouse gas emissions.

### 3.2 Causes of Climate Change

*The causes of climate change in western Uganda manifests in two broad categories i.e Natural and Man-made. For the purpose of this paper, emphasis was on man-made causes.*

Climate change is mainly caused by the production of green house gases from human activities including agricultural production, industrialization, burning of fossil and bio fuels, and deforestation among others (Stern, 2006). These gases react with the thin layer (Ozone) which protects the earth from direct heat from the sun. When this layer is depleted, sun rays hit directly on the earth resulting in temperature raises which influence climate on the earth and these changes manifest as global warming, prolonged droughts, and unreliable rainfall. The developed countries particularly United States of America and European Union member states among others are the largest producers of these emissions and hence the largest contributors to climate change (Praveen, 2005).

#### 3.2.1 Deforestation

According to FAO (2000), a forest refers to land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 ha. In this case, the trees should be able to reach a minimum height of 5 m at maturity. Deforestation is a non-temporary change of land use from forest to other land use or depletion of forest crown cover to less than 10 percent. Clear cuts (even with stump removal) if shortly followed by reforestation for forestry purposes are not considered deforestation (FAO, 2000). Whereas, forest degradation is the impoverishment of standing woody material mainly caused by human activities such as over-grazing, over-exploitation (for firewood in particular), repeated fires, or due attacks by insects, diseases, plant parasites or other natural causes such as cyclones, both processes of deforestation and forest degradation are associated with release of greenhouse gases into the atmosphere.

The accelerating destruction of the rainforests that form a precious cooling band around the Earth's equator is now being recognized as one of the main causes of climate change. Forests generate the bulk of rainfall worldwide and act as a thermostat for the Earth. When they are felled or burned, the carbon dioxide stored by the trees escapes back into the air hence creating change in climate. Equally, trees contribute to the formation of convectional rainfall. Without these trees, rainfall will either reduce or won't be there. The researchers were able to observe scenes of deforestation. Some people interviewed also attributed the changes in climate to the continuous and indiscriminate cutting of trees.



Figure 2: Deforestation in Bushenyi

### 3.2.2 Land degradation

Climate variability, climate change and land degradation are intimately linked and are generating unexpected effects. Land degradation (Figure 3 below) is a threat to natural resources with consequences on food security, poverty, and environmental and political stability. The increasing occurrence of climate extremes is having an impact on land degradation processes.

In Uganda where land is a critical factor in both natural and human management production systems, 130 million ha of lands are seriously touched by this phenomenon. The researchers observed scenes of land degradation that included overgrazing, sand extraction as was the case in Nyeihanga, and uncontrolled planting. All these contribute to climate change in a way that they either lead to extreme flooding, strong winds and or soil erosion.



Figure 3: Land degradation due to sand mining in Nyeihanga - Mbarara District

### 3.2.3 Increased industrialization

Increased and un-controlled industrialization has seen the large-scale use of fossil fuels for industrial activities. Though these industries have created jobs and over the years, people have moved from rural areas to the towns. This trend is continuing even today. More and more land that was covered with vegetation has been cleared to make way for

houses. Natural resources are being used extensively for construction, industries, transport, and consumption. All this has contributed to a rise in greenhouse gases in the atmosphere. Fossil fuels such as oil, coal and natural gas supply most of the energy needed to run vehicles generate electricity for industries, households, etc. The energy sector is responsible for about  $\frac{3}{4}$  of the carbon dioxide emissions,  $\frac{1}{5}$  of the methane emissions and a large quantity of nitrous oxide. It also produces nitrogen oxides (NO<sub>x</sub>) and carbon monoxide (CO) which are not greenhouse gases but do have an influence on the chemical cycles in the atmosphere that produce or destroy greenhouse gases.

### **3.2.4 Increased population**

The population of Uganda is currently between 33 and 37 million (UBOS 2011). 30% of this population lives in Urban areas and Electricity is the main source of power in urban areas. All gadgets run on electricity generated mainly from thermal power plants. These thermal power plants are run on fossil fuels and are responsible for the emission of huge amounts of greenhouse gases and other pollutants. Equally Cars, buses, and trucks are the principal ways by which goods and people are transported in most of Western Uganda. These are run mainly on petrol or diesel, both fossil fuels hence generating too much carbon dioxide responsible for climate change. The Daily monitor of Thursday 27th November- a famous Newspaper in Uganda reported that the second hand imported cars and fridges in Uganda are the major causes of environmental pollution. The writer went on to say that emission of gases from these cars contribute to between 5% to 15% of environmental degradation which in the end result into climate change. The government of Uganda has liberalized the importation of second hand cars from Japan and other European countries. This has made the price of buying a car relatively cheap hence many Ugandans owning cars which in the end contribute to emission of gases that are not environmentally friendly.

A growing population has meant more and more mouths to feed. Because the land area available for agriculture is limited (and in fact, is actually shrinking as a result of ecological degradation!), high-yielding varieties of crop are being grown to increase the agricultural output from a given area of land. However, such high-yielding varieties of crops require large quantities of fertilizers; and more fertilizer means more emissions of nitrous oxide, both from the field into which it is put and the fertilizer industry that makes it. Pollution also results from the run-off of fertilizer into water bodies.

### **3.2.5 Increased use of Polythene bags and bottled water**

The increased population growth in Uganda and western Uganda in particular means that most of the shopping is done in urban centers especially from super markets and shops. These shops try to pack for the customers in bags( polythene bags). But the manufacture of plastic shopping bags produces carbon emissions as well as a host of other environmental problems. The increased consumption of bottled water has contributed to climate change in a way that these plastic is durable means it degrades slowly. In addition, burning plastic can sometimes result in toxic fumes. Due to the irresponsible disposal of the polythene bags and empty plastic bottles, after heavy rains, most of the water channels are blocked causing a lot of flooding (which is one of the signs of climate change) and often times most roads are impassable. Careless dumping of polythene bags is ecologically murderous because their mechanical shredding greatly reduces soil fertility.



Figure 4: Polythene bags disposal in Mbarara Municipality

### 3.2.6 Increased use of gravity water

In an effort to provide clean and safe water to its citizens especially in arid areas of western Uganda, the government with donor partners have emphasized the use of gravity water. The researchers observed that water is being tapped from the mountaneous areas of Kyangenyi in Bushenyi district, Mwizi in Mbarara and some areas in Isingiro. Much as this has solved the water problem in these areas, residents are worried about the sustainability of this. Some residents interviewed said that this gravity water has reduced on the wetlands and some streams and rivers. They said that water used to flow from the mountains coming down to these wetlands and streams which water would later evaporate to form clouds that form rains. However, this is no more.

One resident in Kyangenyi was not happy with all the program of gravity water for he attributed the changes in climate patterns to the gravity water. He had this to say “ ever since this business of gravity water started, we no longer see water in the valleys. The wet lands are drying up slowly. We are worried that in the future we may not get water”.

### 3.2.7 Greenhouse gases and their sources

Carbon dioxide is undoubtedly, the most important greenhouse gas in the atmosphere. Changes in land use pattern, deforestation, land clearing, agriculture, and other activities have all led to a rise in the emission of carbon dioxide. Methane is another important greenhouse gas in the atmosphere. About ¼ of all methane emissions are said to come from domesticated animals such as dairy cows, goats, pigs, buffaloes, camels, horses, and sheep. These animals produce methane during the cud-chewing process.

Methane is also released from rice or paddy fields that are flooded during the sowing and maturing periods. When soil is covered with water it becomes anaerobic or lacking in oxygen. Under such conditions, methane-producing bacteria and other organisms decompose organic matter in the soil to form methane. Methane is also emitted from landfills and other waste dumps. If the waste is put into an incinerator or burnt in the open, carbon dioxide is emitted. Methane is also emitted during the process of oil drilling, coal mining and also from leaking gas pipelines (due to accidents and poor maintenance of sites).

A large amount of nitrous oxide emission has been attributed to fertilizer application. This in turn depends on the type of fertilizer that is used, how and when it is used and the methods of tilling that are followed. Contributions are also made by leguminous plants, such as beans and pulses that add nitrogen to the soil.

### **3.2.8 Increased planting of trees on the river banks**

The construction industry is one of the fastest growing industries in Uganda. This has resulted into the demand for wood and timber products to be so high. As a result, because people want to make fast money from wood, they have been forced to plant trees so as to reap timber from these trees. Unfortunately, some people have not been mindful of the trees they plant and where they plant them. There are scenarios where individuals have planted trees on the river banks because that is the only available land. Eventually, these trees consume the water in these rivers hence drying up of the rivers. Equally, these people don't mind about the type of trees they plant. The type of trees planted are those whose leaves have small surface such as pine and eucryptus trees. These trees whose leaves have a small surface have been found to consume a lot of water. Research( un published) show that on average a mature eucryptus tree consumes 16 liters daily.

### **3.3 Concept of Land use**

**Land use** is the human use of land. Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements. It has also been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it" (FAO, 1997a; FAO/UNEP, 1999).

Land use practices vary considerably across the world. The United Nations' Food and Agriculture Organization Water Development Division explains that "Land use concerns the products and/or benefits obtained from use of the land as well as the land management actions (activities) carried out by humans to produce those products and benefits." As of the early 1990s, about 13% of the Earth was considered arable land, with 26% in pasture, 32% forests and woodland, and 1.5% urban areas.

The major effect of land use on land cover since 1750 has been deforestation of temperate regions. More recent significant effects of land use include urban sprawl, soil erosion, soil degradation, salinization, and desertification. Land-use change, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide, a dominant greenhouse gas. Land use is the way land is developed and used in terms of types of activities allowed such as agriculture, industries and residence. Deforestation, urban sprawl, agriculture, and other human influences have substantially altered and fragmented the landscape. Such disturbance of the land can change the global atmospheric concentration of carbon dioxide, the principal heat-trapping gas, as well as affect local, regional, and global climate by changing the energy balance on Earth's surface.

Current efforts to combat global warming focus on reducing the emission of heat-trapping gases, but do not fully address the substantial contribution of land use to climate change.

Human activity is vastly altering the Earth's vegetative cover. Such changes have considerable consequences for the health and resilience of ecosystems and for human welfare.

These include the growth or degradation of surface vegetation, which produces changes in the global atmospheric concentration of carbon dioxide; and changes in the land surface, which affect regional and global climate by producing changes in the surface energy budgets.

The issues under land use that have been observed in western Uganda include:



- Farming
- Construction
- Excavation
- Mining
- Land reclamation
- Industrialization

### **3.3.1 Impact of agriculture as a land use activity on climate change**

Modern agriculture, food production and distribution are major contributors of greenhouse gases:

Agriculture is directly responsible for 14 per cent of total greenhouse gas emissions, and broader rural land use decisions have an even larger impact. Deforestation currently accounts for an additional 18 per cent of emissions.

The agricultural sector is a driving force in the gas emissions and land use effects thought to cause climate change. In addition to being a significant user of land and consumer of fossil fuel, agriculture contributes directly to greenhouse gas emissions through practices such as rice production and the raising of livestock; according to the Intergovernmental Panel on Climate Change, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture

Agriculture contributes to greenhouse gas increases through land use in four main ways:

- CO<sub>2</sub> releases linked to deforestation
- Methane releases from rice cultivation
- Methane releases from enteric fermentation in cattle
- Nitrous oxide releases from fertilizer application

Together, these agricultural processes comprise 54% of methane emissions, roughly 80% of nitrous oxide emissions, and virtually all carbon dioxide emissions tied to land use.

The planet's major changes to land cover since 1750 have resulted from deforestation in temperate regions: when forests and woodlands are cleared to make room for fields and pastures, the temperatures of the affected area increases, which can result in either warming or cooling effects, depending on local conditions. Deforestation also affects regional carbon reuptake, which can result in increased concentrations of CO<sub>2</sub>, the dominant greenhouse gas. Land-clearing methods such as slash and burn compound these effects by burning which directly releases greenhouse gases and particulate matter such as soot into the air.

### **3.3.2 Livestock as a land use practice towards climate change**

Livestock and livestock-related activities such as deforestation and increasingly fuel-intensive farming practices are responsible for over 18% of human-made greenhouse gas emissions, including:

- 9% of global carbon dioxide emissions
- 35–40% of global methane emissions chiefly due to manure
- 64% of global nitrous oxide emissions (chiefly due to fertilizer use).

Livestock activities also contribute disproportionately to land-use effects, since crops such as corn and alfalfa are cultivated in order to feed the animals.

Worldwide, livestock production occupies 70% of all land used for agriculture, or 30% of the land surface of the Earth.

### **3.3.3 Excavation as a land use practice on climate change**

This new phenomenon is on the increase in Uganda. There is a lot of excavation in form of extracting soil, sand, stones and rocks is very common in western Uganda. This to some respondents contributes to climate change in a way that there is a lot of carbon dioxide emission in the atmosphere. The respondents asked in Rwampala sub-county of Mbarara district were of the view that the reduction in the water levels in the area are a result of the depleted mountains.

### **3.3.4 Land reclamation practices on climate change**

Because of population explosion, and the static land available, the only available chunk of land available are the swamps, river banks, marshlands. These areas have been contributing significantly to the water levels. However, due to lack of enough land, these areas have been reclaimed to pave way for agriculture. These areas that used act as catchment areas have been destroyed hence contributing to climate change. Residents interviewed as regards the depletion of swamps said that ever since these swamps were reclaimed, the amounts of rain reduced. The practice of land reclamation was found in the areas of Rwampala, Kashari and Mwiizi where there used to be big chunks of swamps and used to receive adequate rainfall are no more.

## **3.4 Food Security**

The Food and Agriculture Organization (FAO) defines food security as a “situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (1). This definition comprises four key dimensions of food supplies: availability, stability, access, and utilization.

## **3.5 Climate Change and Food Security**

### **3.5.1 Impacts on food production and availability**

Climate change affects agriculture and food production in complex ways. It affects food production directly through changes in agro-ecological conditions and indirectly by affecting growth and distribution of incomes, and thus demand for agricultural produce. Impacts have been quantified in numerous studies and under various sets of assumptions (IPCC 2007).

### **3.5.2 Impacts on the stability of food supplies**

Global and regional weather conditions are also expected to become more variable than at present, with increases in the frequency and severity of extreme events such as cyclones, floods, hailstorms, and droughts (IPCC 2001). By bringing greater fluctuations in crop yields and local food supplies and higher risks of landslides and erosion damage, they can adversely affect the stability of food supplies and thus food security. Neither climate change nor short-term climate variability and associated adaptation are new phenomena in agriculture.

### **3.5.3 Impacts of climate change on food utilization**

Climate change will also affect the ability of individuals to use food effectively by altering the conditions for food safety and changing the disease pressure from vector, water, and food-borne diseases. The IPPC examines how the various forms of diseases, including vector borne diseases such as malaria, are likely to spread or recede with climate change. This article focuses on a narrow selection of diseases that affect food safety directly, i.e., food and water-borne diseases. The main concern about climate change and food security is that changing climatic conditions can initiate a vicious circle where infectious disease causes or compounds hunger, which, in turn, makes the affected populations more susceptible to infectious disease. The result can be a substantial decline in labor productivity and an increase in poverty and even mortality. Essentially all manifestations of climate change, be they drought, higher temperatures, or heavy rainfalls have an impact on the disease pressure, and there is growing evidence that these changes affect food safety and food security.

### **3.5.4 Impacts of climate change on access to food**

Access to food refers to the ability of individuals, communities, and countries to purchase sufficient quantities and qualities of food. Climate change has impacted negatively on food security in a sense that during el-Niño rains, some roads are made impassable hence making it hard to reach some areas which food to areas which do not have food. This therefore means that in some areas, they are unable to access food.

### **3.5.5 Impacts on food prices**

Essentially all SRES development paths describe a world of robust economic growth and rapidly shrinking importance of agriculture in the long run and thus a continuation of a trend that has been underway for decades in many developing regions.

Changing weather patterns or extreme weather events, such as floods or droughts, can have negative consequences for agricultural production. As a result, people have less access to food, which forces them to buy food products. This affects their financial situation. It also influences their health as people often buy cheap food which is frequently less nutritious. Especially for those who need a nutritious diet- the chronically ill, this poses a problem. Climate change also leads to pest outbreaks that further weaken food systems. Climate change induces outbreaks of pests and weevils such as the desert locusts. In the case of outbreak of an outbreak, locusts are capable of destroying crops hence leaving nothing to harvest. Equally so, extreme temperatures are conducive for weevils' that destroy stored food like beans, maize, millet and sorghum.

Climate change not only impinges on the cultivation of crops, the fishing industry which used to provide free nutritious food in form of fresh is also affected in western Uganda. Fish stocks in lake Kacyera and river Rwizi are declining because of the declining water levels due to evaporation as a result of rising temperatures.

## **4 Conclusions**

Climate change will affect all four dimensions of food security, namely food availability (i.e., production and trade), access to food, stability of food supplies, and food utilization (1, 43). The importance of the various dimensions and the overall impact of climate

change on food security will differ across regions and over time and, most importantly, will depend on the overall socio-economic status that a country has accomplished as the effects of climate change set in.

## **References**

- [1] Stern, N. (2006). "Stern Review on the Economics of Climate Change. HM Treasury, London. Archived from the original on 31 January 2010. Retrieved 31 January 2010. <http://www.ipccfacts.org>
- [2] NAPA. (2007). National Adaptation Program of Action on Climate Change in Uganda. <http://www.preventionweb.net/english/policies/v.php?id=8578&cid=180>
- [3] Intergovernmental Panel on Climate Change (2007) Climate Change: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge Univ. Press, Cambridge, UK), in press.
- [4] Intergovernmental Panel on Climate Change (2001) Climate Change: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge Univ. Press, Cambridge, UK).
- [5] Jaeker, W. G., & Plantinga, A. J. (2007). How have land-use regulations affected property values in Oregon? OSU extension
- [6] IPCC Special Report on Land Use, Land-Use Change And Forestry, 2.2.1.1 Land Use
- [7] FAO Land and Water Division retrieved 14 September 2010
- [8] Intergovernmental Panel on Climate Change
- [9] UN Land Degradation and Land Use/Cover Data Sources ret. 26 June 2007
- [10] UN Report on Climate Change retrieved 25 June 2007 from Web archive