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# **Challenges of Climate Change and Bioenergy**

Jahangir, Daniyal

DH Chemicals Limited - Pakistan

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# **CHALLENGES OF CLIMATE CHANGE** **& BIOENERGY**

Third world war might not be such a grave concern for the people living in this world, because they have become aware of the fact that if it started, no one is going to survive on the surface of the planet & the leaders of the world became conscious. Yet what about environment & climate which is getting depleted, polluted, oxygen less day by day, resulting in a change in climatic conditions all over the globe. Today the Earth is a giant laboratory in which humans are conducting thoughtless experiments that is having serious consequences over the climatic conditions. Today we find various parts of the world caught mercilessly in the perilous jaws of many changes in the global climate system.

In order to mitigate global climate changes, the world has diverted its attention from conventional energy resources to **BIOENERGY**, but still there is high uncertainty that can bioenergy really deliver? The challenges posed by Climate change and Bioenergy Sector are many and complex. In the following sections of this Essay, we will discuss various challenges and threats, posed by bioenergy and abrupt climate changes, to our planet and the people living on it.

## **Overview of Climate Change:**

Small scale individual actions may seem harmless, but when carried out globally their total effect can add up to create serious change in the climatic conditions of various regions on the earth. Atmospheric concentration of the Green House Gases, Carbon Dioxide, Methane and Nitrous Oxide has increased largely since Industrial Revolution. Continued GHG emissions at or above current rates would cause further warming and induce many changes in global climate system. According to an estimate by 2005, the global atmospheric concentration of Carbon dioxide far exceeded the natural range of

the preceding 650,000 years. Rising Global Temperatures are striking the glaciers and melting the ice on the poles, causing sea levels to rise around the world.

*Average arctic temperatures increased at almost twice the global average rate during the past 100 years.*

**Intergovernmental panel on the climate change (IPCC)** is a scientific body set up by the UN world Metrological Organization and the UN Environment Program to provide various governments with necessary information about climate change. According to an IPCC report, unmitigated emissions of GHG's would cause the sea-level rise by 40 centimeters by 2080's, with 60 % of this increase occurring in South East Asia. Overgrazing of livestock and deforestation also contribute to land degradation and Climate Change.

## **CHALLENGES OF CLIMATE CHANGE:**

Climate changes will lead to more intense and longer droughts than have been observed over wider areas since 1970's. It is primarily via these impacts that climate change will have negative impacts on **global environment, biodiverse ecosystems, food security, water security, human health and nutrition**. In the following section of this Essay, we will try to have a clear view of the challenges posed by the Global Climatic Change to us.

### **(A)-Climate Change Impacts on Global Environment:**

Climate Change is adversely affecting the global environment. However the vulnerability to adverse effects from climate change differs by region, ecosystem and gender. Rising global temperature is reducing the thickness and extent of glaciers and ice sheets with detrimental effects on many organisms including migratory birds and

mammals. This would cause the sea levels to rise which might put many coastal areas (like Karachi, Mumbai and one third of Bangladesh) permanently under water.

### **(B)- Climate Change Challenge to Ecosystems:**

Climate Change & its associated disturbances (drought, ocean acidification, flooding, and wildfire) can upset the balance of many vulnerable ecosystems on Earth. Examples of delicate ecosystems that are already being affected include the Tundra, Boreal Forests, Mountains and Mediterranean region.

**About 20-30% of Plant & Animal species assessed so far are likely to be at risk of extinction if global average temperature exceed by 1.5-2.5 C.**

### **(C)-Global Climate Change Impacts on Food Security:**

There are four recognized dimensions of food security:-

1. Food availability (Production and trade )
2. Stability of food supplies.
3. Access to food
4. Food utilization

**Climate change will affect all four dimensions of food security.** Globally, the potential for food production is projected to increase with increase in local average temperature over a range of 1-3 °C, but once this limit exceeds food production is projected to decrease. But different stats suggests us that temperature is increasing beyond this limit (1-3 °C) and also Carbon dioxide increases and rainfall changes are having small beneficial effects on major rain fed crops i.e. maize, wheat and rice. In dry and tropical region, even slight warming (1-2 °C) reduces yield. Warming above a range of 1-3 °C has increasingly negative impacts on global food production in all regions.

**Ironically, agriculture is not only victim of climate change; it is also a source of GHG's. Crops production and live stocks release GHG's into the air and are responsible for the major part of the methane (from cattle and wetlands) and nitrous oxide (from fertilizer use). Also deforestation and soil degradation emits large amounts of carbon into atmosphere thus contributing to global warming.**

Climate changes can also affect the **STABILITY OF FOOD SUPPLIES** in the way that climate related animals and plant pests and diseases can certainly influence the stability of production system. It can also reduce **FOOD ACCESS** through;

- Reduction of yields of food and cash crops
- Lowest forest productivity
- Changes in Aquatic Population
- Increased Costs of Control
- Reduction in income from animal production

#### **Rise in Food Prices & its Negative Impact on Food Access:**

These factors should certainly shoots up food prices which would have an impact on food access, by limiting the acquisition of appropriate foods for the nutrition diet.

**According to a study by FAO, temperature increase of more than 3 °C may cause prices to increase by up to 40 %.**

Climate changes would also affect **FOOD UTILIZATION** seriously as the Concept of food utilization refers respectively to the;

- Possibility of individuals to have access to adequate food at all times.
- People's ability to utilize and absorb nutrients

#### **Pathways through which climate change may impact food security are:**

- Influence on plant diseases and pest's species and Livestock diseases including Zoonosis, leading to crop and animal losses.
- Damage to Forestry, Livestock, Fisheries and Aquaculture.

- Crop Production through Carbon dioxide (CO<sub>2</sub>) fertilization.
- Flooding of coastal areas leading to salination and contamination of agricultural lands and hence posing a threat to food availability.

#### **(D)-Climatic Change Impacts on Aquaculture Production:**

Water temperature increase is leading to changes in the distribution of marine fisheries and community interactions. Atmospheric increase of carbon dioxide is raising ocean acidity, which affects bleaching and balance of the food web. Climate changes are hereby affecting the marine eco-system very seriously. Higher ocean temperatures are leading to increased levels of methyl mercury in fish and marine mammals, prompting recommendation to limit the intake of fish and marine fats by pregnant women and indigenous people in the Polar Regions.

#### **(E)-Climate Change Challenge to Water Security:**

Access to safe water remains an extremely important global health issue. According to WHO report more than 2 billion people live in the dry region of the world and suffer infant mortality and diseases related to contaminated and insufficient water. The impacts of global climate change on water security are a great concern, particularly for developing countries.

- **A study suggests that by 2080, 1.1—3.2 billion people will be experiencing water scarcity.**
- **Another study tells us that by 2020, in Africa about 75-250 Million people are projected to be exposed to increased water stress due to climate change.**

The impacts of climate change on fresh water system and their management are, mainly due to increase in:

- Temperature
- Sea level &
- Precipitation variability

Some other challenges to water security posed by climate changes are sea-level will rise in coastal areas and this will extend areas of salination of ground water, resulting in a decrease in fresh water availability.

Climate changes can exacerbate declining reliability of irrigation water supplies leading to increased competition for water for industrial, agricultural and house hold uses.

### **Results of Water Shortage:**

Water scarcity in turn may lead to

- Adverse health outcomes
- Water-born diseases
- Exposure to chemicals
- Malnutrition

### **Pathways through which Climate Change impacts Water Security:**

Some of the pathways through which climate change and variability may impact water security are:

- Sea-level rise (due to Global Warming) which will extend areas of salination of groundwater, resulting in decrease in coastal freshwater availability for humans and ecosystems.
- Flooding of coastal land leading to contamination of water.
- Impacts of temperature increase and water scarcity on plant or animal physiology.

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*According to a special report, 2-7 million people per year will be affecting by coastal flooding by 2080.*

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### **(F)-Climate Change Challenge of Hunger and Nutrition (Human Health):**

Drought and water scarcity can lead to negative effects on nutrition through:

- Increased infections

- Mortality
- Reduced food availability

Malnutrition increases the risk of dying from the infectious diseases. Climate change is projected to increase the burden of diarrhoeal disease in low-income region approximately 2-5 % in 2020.

**Countries with an annual GDP per capita of US \$ 6000 or more are around to have no additional risk of diarrhea.**

**In Bangladesh the impacts of drought and lack of food are associated with an increase risk of mortality from diarrhoeal illness.**

Climate change is also projected to increase the number of people at risk of hunger, according to FAO. It is estimated that food and water scarcity, due to climate change, will cause 200-600 Million people to be affected by hunger, by 2080.

Also projected climate-change related exposures are likely to affect health status of millions of people through:

- Increased burden of diarrhoeal diseases
- Increased deaths and diseases due to heat-waves, floods, storms and droughts.
- Increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone related to climate change.

### **Remarks:**

All these aspects clearly show how climate change and agricultural markets water reservoirs & human health are closely linked. For this reason the abrupt climate changes inevitably affect the life of people in various developing countries of the world particularly South Asia and Sub-Saharan region. This would lead to an unprecedented rise in food prices, which would seriously affect the access of common man to food items and hence the world, particularly people of the developing regions, would be caught in the clutches of hunger and malnutrition. Beyond any doubt, Challenges of Global



Climate Change are grave and hard to tackle with and the “Policy making Actors” now need a serious effort to overcome the threats posed by global climate changes. The expiration of the **Kyoto Protocol** in 2012 offers an opportunity to bring this issue to the table as a new agreement is negotiated.

## **Bioenergy & Its Challenges:**

### **Overview**

Bioenergy is energy produced from organic matter or biomass. When biomass is produced in a sustainable manner, it is a renewable energy source. It stores chemical energy that can be used to produce power and heat. Bio fuels are energy carriers derived from biomass. Some historic & conventional sources of bioenergy are fuel wood, charcoal and animal dung.

There are two generations of biofuels;

1. First generation biofuels
2. Second generation biofuels

### **First generation Biofuels:**

First generation bio-fuels are derived from food crops. Most important among them are;

- **Ethanol**
- **Biodiesel**

Ethanol can be made from sugars (e.g. sugar beets, sugarcane); grains (maize & wheat), cellulose & waste products. Sugar from Brazil and Maize from USA comprise around 80% of global ethanol production. **In energy terms, ethanol accounts for almost 90% of current total biofuel use.**

Biodiesel is made from vegetable oil or animal fats biodiesel mostly produced and used in Europe.

## **Second Generation Biofuels:**

Second generation biofuels are derived from the residual non-food parts of crops, such as stem, leaves and husks that are left behind once the food crop has been extracted. Second generation biofuels also include other crops that are not used for food purpose such as Switch Grass. **Second generation biofuels are not likely to increase food prices. Also they are more helpful in mitigating climate changes as compared to first generation biofuels.**

Rising oil prices have led to increased interest in biofuels as an alternative energy source. By April 2008 crude petroleum prices were as much as \$120. The following section will describe the potential benefits of Bioenergy.

## **Benefits of Bioenergy:**

The potential benefits of bioenergy development are as under:

- Its ability to compete with petroleum prices
- Its ability to mitigate climate changes
- Its capacity to reduce GHG emission
- Its ability to enhance farmer's income
- Diversification of agriculture outputs
- Domestic energy supply
- Job creation in rural areas
- Development of infrastructures
- It is projected that biofuels will meet 3.2% of world road-transport fuel demand by 2030. (Source: World Energy Outlook)

**The primary motives behind promoting the development of bioenergy is climate change mitigation, energy security and agricultural and rural development. But can biofuels reality deliver?** There is also a negative facet of the story. There are

several challenges posed by the increased usage of bioenergy. Growth of bioenergy sector may lead to:

- Food shortages,
- Water shortages,
- Malnutrition
- Rise in the food prices,
- Soil erosion,
- Deforestation

& many other challenges that are still unknown to us.

In the following section of this Essay, we will try to have a clear view of challenges of bioenergy.

## **CHALLENGES OF BIOENERGY**

### **(A)-Diversion of Food to Fuel and Rise in Food Prices:**

Availability of food can be threatened to the extent that land, land, water & other productive resources are diverted from food production to biofuel production.

- **According to a study, in 2008, 24% of US maize crop projected to go into ethanol production.**
- **In 2007, 54% of Brazil's sugar-cane crop production was used to produce ethanol.**
- **In the European Union, about 47% of vegetable oil production was used in the production of biodiesel causing higher imports of vegetable oil to meet domestic consumption needs.**

There is another risk that food and feed production will be consigned to less productive land, which may result in lower yields, while the most fertile lands will be cultivated for high-value fuel crops. Agrofuel plantations in Brazil and Southeast Asia are being

created on the territories of indigenous people and local subsistence farmers, who are being forced to give up their land, way of life, and food self sufficiency to grow fuel crops for export. **The increased biofuel demand have accounted for a substantial increase in food prices.**

### **Rise in Food Prices Results in Decreased Food Consumption**

A rise in food prices will tend to result in reduced access to food of higher value. As prices continue to rise, poor people (who represent a majority of net buyers of food) will experience a worsening of dietary quality and micronutrient intake and extremely poor people will experience an additional decrease in food energy consumption.

### **Results of Decreased Food Consumption**

Decreased food consumption in terms of calories, proteins, fats and micronutrients can lead to:

- Weight loss
- Impaired development
- Impaired mental and physical growth in children
- Reduction in physical ability to do work for adults

**A study suggests that in East Asian setting a 50% increase in price of food (holding income constant) will lead to decline of iron intake by 30%. As a result, prevalence of micronutrient deficiency among women and children will increase by 25%.**

Recently “The Economist” Magazine editorialized:

**“Roughly a billion people live on \$1 a day. If, on a conservative estimate, the cost of their food rises 20% (and in some places it has risen a lot more), 100 Million people could be forced back to absolute poverty.”**

### **(B)-Increased GHG Emissions Connected with Biofuel Production:**

Biofuel production can disturb GHG emissions balance through increased GHG emissions that may result from burning forests to clear land for crop cultivation, which causes less absorption of carbon dioxide and hence GHG concentration increases in the biosphere, which may result in more global warming.

Key sources of emissions from bioenergy development are:

- Land Conversion
- Mechanization
- Fertilizer use at feedstock production stage
- Use of non-renewable energy in processing and transport

### **(C)-Expanded Bioenergy Sector Poses a Challenge of Water Scarcity:**

Development of bioenergy sector may lead to water shortages.

- Use of sugarcane as a feedstock is particularly water intensive.
- Increased cultivation of biofuel crops could result into loss of availability of drinking water in many regions of Earth.

Water scarcity in countries of South Asia and Sub-Saharan Africa is a cause of concern for agricultural productivity, health and sanitation.

### **More Challenges:**

#### **(D)-Water Pollution & Soil Erosion:**

Biofuel Crops such as soybean and corn contribute to soil erosion & water pollution and require large amount of fertilizer, pesticides and fuel to grow, harvest & dry. Also poorly managed input use in bioenergy crop cultivation could pollute drinking water, adversely affecting human and animal health.

### **(E)-Threat to Biodiversity:**

Planning for expanding bioenergy sector involve the creation of large scale monocropping plantation, which threaten some of the most biodiverse ecosystems on the Earth. The threat to wild biodiversity from bioenergy growth is associated with land-use change. When areas such as natural forests are converted for feedstock production, the loss of biodiversity may be significant.

### **FAO High Level Conference:**

At June 3-5, 2008 Food and Agricultural Organization (FAO) High Level Conference on “World Food Security: The Challenges of Climate Change and Bioenergy” took place. The conversion of foodstuffs like maize, sugar and palm oil into biofuels was one of the most controversial issues in that High Level Conference. During the summit the biofuel giants, USA & Brazil remarked against countries that fear the harmful effects of bioenergy and under their pressure, the final declaration avoided negative language on this issue. US and Brazil states that bioenergy present “Challenges and Opportunities” & call for an “International Dialogue” on the matter.

On the other hand, 3 member states of FAO, Argentine, Cuba and Venezuela did not adopt the declaration on the grounds that rich and powerful states want to block true solutions to world hunger and condemned monopolies on agriculture.

In the conference, a lack of focus on the development of second generation biofuels seemed a surprising aspect, because first-generation biofuels compete with food crops. Also first-generation biofuels contribute to climate change which is a serious challenge to food security.

### **Managing Bioenergy - The Global Perspective:**

The different viewpoints on managing bioenergy sector globally can be summarized under three main options:

- Business as usual

- Moratorium
- Intergovernmental Consensus Building

**Option No. 1:**

The “Business as usual” option focuses continuing along the path taken so far.

**Option No.2:**

The “Moratorium” option denotes a temporary prohibition of production.

**Option No.3:**

Intergovernmental Consensus building on sustainable bioenergy sector assumes that policy making on sustainable biofuels is necessary but may not be sufficient for sustainable bioenergy development.

**Bioenergy & Climate Change- The Challenge of Sustainable**

**Development:**

To develop the full potential of bioenergy so as to mitigate abrupt global climate changes, growth has to be managed in a sustainable way to meet requirements related to socio-economic and environmental dimensions of sustainability. The emerging bioenergy market should build upon following lessons to meet the above described challenges:

- Proper management and appropriate policies can make bioenergy development more pro-poor and environmentally sustainable. Poor farmers might be able to grow energy crops on degraded lands, not suitable for food production. But appropriate fertilizer management, soil type and climatic conditions are to be considered in order to prevent soil erosion, environmental problems, GHG emissions & harmful climate changes.
- Proper research and institutional arrangements can prevent a negative impact on food availability, climate and poverty. Bioenergy sector is labor intensive. Optimized production will open new vistas for employment (without disturbing

ecosystems). A study shows that in 1997, in Brazil, the ethanol sector employed about 1 Million people.

### **Conclusion:**

Taking all these factors into account, it is clear that International Community is facing difficulties in coping with the challenges posed by Climate change and Bioenergy. On one hand, climate changes and current bioenergy policies and practices run the risk of undermining food security and degrading ecosystems through deforestation and agrochemical pollution. On the other hand well-managed “second generation” biofuels can contribute to a more sustainable energy future and climate change adaptation. **Thus it can be concluded that the challenges posed by Climate change and Bioenergy are grave, without any doubt, but research is underway to manage biofuels in a global perspective and it could help us in overcoming many problems including Climate Change Mitigation, if managed successfully.**