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CLIMATE CHANGE: IMPACTS ON AGRICULTURE IN OIC MEMBER COUNTRIES

Attar Sokak No: 4, 06700 GOP, Ankara, TURKEY
Tel: +90-312-468 6172 (4 lines) **Fax**: +90-312-467 3458
E-mail: oicankara@sesric.org **Web**: www.sesric.org

OIC OUTLOOK

CLIMATE CHANGE: IMPACTS ON AGRICULTURE IN OIC MEMBER COUNTRIES

INTRODUCTION

Today, climate change is one of the most crucial environmental challenges with serious negative socio-economic consequences. Although, triggered both by natural and human induced reasons, climate change is underway since centuries with increasing frequency and intensity in recent decades compared to the past trends. During the last few decades, human activities related mainly to industrial production, agriculture and transportation emerged as the major contributor to the concentration of greenhouse gases (GHGs) in the atmosphere. According to the scientists the concentration of the GHGs, especially Carbon Dioxide (CO_2), has increased by 70 % since 1970 (EU Agriculture, 2007). Increasing concentration of GHGs emissions is causing global warming (i.e. increase in the Earth's surface mean temperature) which is one of the most common manifestations of climate change. In addition, timing and amount of rainfall is changing, level of precipitation become highly variable and occurrence of extreme weather events like floods, draughts, cyclones and storms is more often compared to the past. Changes in these important variables have severe negative implications for human binges as they affect negatively the availability of basic necessities like food and water and deteriorate the health conditions.

Undoubtedly, agriculture sector is extremely vulnerable to the climate change mainly due to its higher dependence on climate and weather conditions. Impact of climate change on some important indicators like temperature, rainfall, soil moisture and Carbon dioxide (CO_2) concentration are very crucial for the agriculture sector and food production across the globe. Increasing temperatures reduces yields of many important crops and thus encourages the weed and pest proliferation. Changes in precipitation patterns increase the chances of crop failure and hence decrease in production. However, globally impacts of climate change on agriculture sector are uneven and some regions are expected to be more affected than the others. Developing countries in arid, semi-arid and dry sub humid regions are more vulnerable to climate change compared to the developed countries due, mainly, to their existing warm climate and higher variability of rainfall and precipitation.

Being a substantial part of developing world, OIC member countries are no exception and most of them are expected to experience high losses in their agriculture production due to negative impacts of climate change. The most vulnerable are the member countries in Sub-Saharan Africa as their economies are based mainly on agriculture sector. The OIC member countries in Sub-Saharan Africa are expected to suffer severe impacts of climate change due to their geographic location, higher prevalence of undernourishment and low financial capacity to adapt and mitigate the negative impacts of climate change. Given this situation, this report highlights the impacts of climate change on some important agricultural variables in OIC member countries like water resources, soil fertility and weather patterns. It investigates how changes in these crucial indicators will affect agriculture productivity in these countries, particularly food production. It also suggests some relevant policy measures for the preparation of an efficient agriculture strategy, both at national and intra-OIC level, to adapt and mitigate the negative impacts of climate change on this important sector.

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE SECTOR

Climate change can affect agriculture sector through various channels among them are temperature rise, rainfall and precipitation distribution, carbon concentration, extreme weather events like floods, drought and storms, and intensification of pest growth. The level and extent of effects of these changes on agriculture production are highly uncertain and various climate models used for the estimation of these effects gave results with significant variations. However, these variations are mostly for the short to medium term periods (up to the period 2030-2050), but in long rum most of the models predicted aggregate negative impact of climate change on agriculture sector at global level (UN IPCC, 2007).

According to the Fourth Assessment Report of the UN Intergovernmental Panel on Climate Change (UN IPCC 2007), the average global temperature has risen by 0.74ºC since 1800s and is expected to continue to increase by 1.8ºC to 4ºC until 2100. Relative to a 1990 baseline under an A1B scenario[1], median temperature rise in Sub-Saharan Africa is projected to be 3.2ºC to 3.6ºC, for Middle East and North Africa 3.5ºC, for Asia 2.5ºC to 3.7ºC and for Latin America 2.5ºC to 3.3ºC (Padgham, J. 2009). As crops are highly sensitive to the temperature and grow only in a suitable environment, for any increase in temperature above their tolerance level, crops will respond negatively and it will be a major cause of decrease in crop yields especially in semi-arid tropic and sub tropic regions. In these regions, temperature is already tend to be close to crops tolerance level. Another related impact of higher temperature on crops is known as evapotranspiration. As increasing temperature affect the ability of plants to get and use moisture while on the other hand, evaporation from the soil accelerates when temperatures rise. As a result, plants increase transpiration and lose more moisture from their leaves. This phenomenon negatively impacts the plants life cycle and production capacity.

At the global level, generally developing countries are expected to be more exposed to these negative impacts compared to the developed countries and, thus, their agriculture production is estimated to decline significantly. Impacts are estimated to be strongest across Africa and Western Asia where yields of the dominant regional crops may fall by 15–35% once temperatures rise by 3ºC or 4ºC (Stern Review, 2006). Sub-Saharan Africa is expected to be worst affected, causing the largest contraction of agricultural production and income. Being located in already dry and warm areas, most of the OIC countries will suffer negative impacts of climate change sue to increase of temperature. Their agriculture production is particularly vulnerable to the increasing warming as even 1°C increase in local temperature may result in 5-10% decline in yields for major cereal crops in semi-arid and tropic areas, where most of the member countries are located.

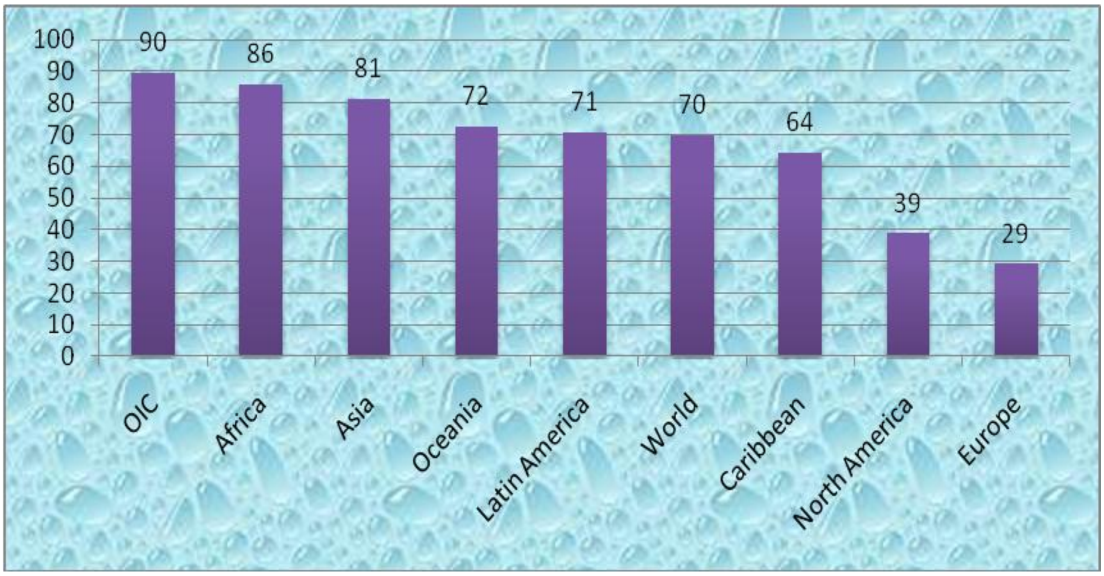
Globally, water resources are vulnerable to the climate change due to its effects on rain fall, melting of snow and level of precipitation. The net impacts of climate change are projected to be negative on global water supply. According to the estimates of FAO

[1] The A1B scenario is one of the scenarios developed by the Special Report on Emissions Scenarios (SRES) used in the IPCC Fourth Assessment Report. It assumes a balanced use of fossil fuel and non fossil fuel energy sources.

(2007), climate change is expected to account for about 20% of the global increase in water scarcity and countries that currently suffer from water shortages will be hit hardest. Renewable water resources are already under stress across the globe and on average per capita renewable water resources have declined from 10180 m^3 in 1992 to 8350 m^3 in 2007 (FAO, AQUASTAT 2008). Semi-arid and dry regions will the most affected due to decrease in rainfall and higher rates of evapotranspiration, and runoff is projected to decrease by 10 to 30% in these regions. As a result, by the mid-century, the globally dry land will be doubled (UN IPCC, 2007).

Water is essential for the food production and globally agriculture accounts for nearly 70% of the total water consumption. In developing regions like Africa and Asia agriculture accounts for 86% and 81% of total water consumption, respectively. This ratio is much higher in the OIC countries and agriculture accounts for 90% of total consumption of renewable water in these economies (Figure 1). Rain fall is the main source of water on the Earth and nearlly 55% of the gross value of our food is produced under rainfed conditions on nearly 72% of the world's harvested cropland (IWMI, 2007). Semi-arid and dry areas are more vulnerable to climate change as their agriculture sector relies heavily on rainfall. The analysis of 20 years of rainfall data from a semi-arid maize area in the Eastern Africa, shows that occurance of dry spells between rains were very often and caused significant maize yield reductions, in some cases up to 75% (Barron 2003).Therefore, expected increase in temperatures and seasonal rainfall variability (including longer dry spells between rains) due to the climate change will cause significant decrease in agriculture production of these areas.

Figure 1: Share of Agriculture in Total Water Consumption (%)



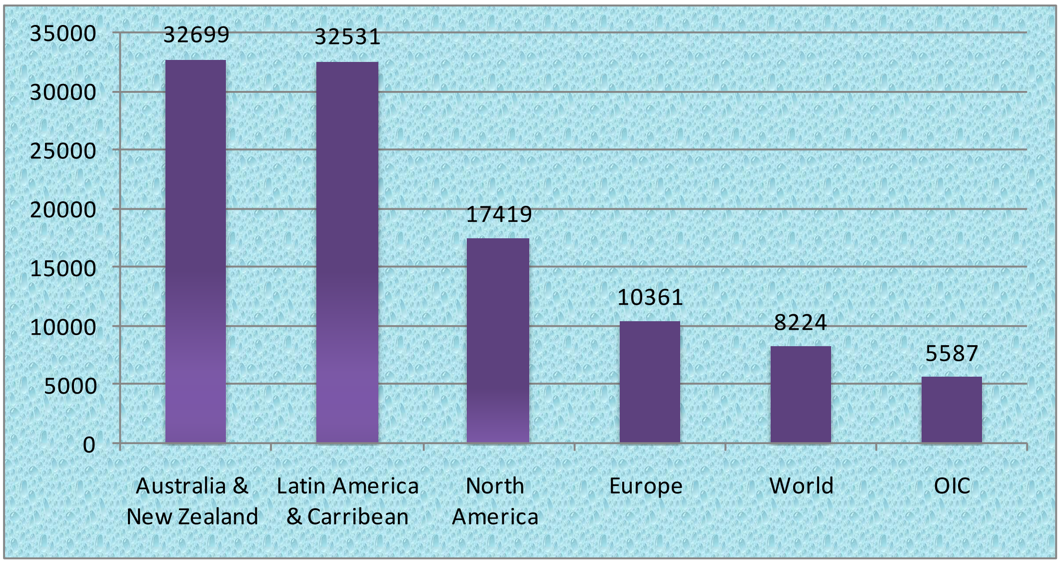
Source: FAO, AQUASTAT online database 2009.

Irrigation based agriculture systems are also vulnerable to the changing climate. Irrigated land currently produces 40% of the world's food on 17% of its land and nearly half of this depends on snow and glacial melt from Himalyas. Glaciars are an important source of water for irrigation in the Central Asia, parts of the Himalayas Hindu Kush, China, India, Pakistan and parts of the Andes. Nearly 35% of the crop production in Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan is based on irrigation, providing food for 2.5 billion people. However, melting of glaciars due to global warming will cause significant decrease in water supply for irrigation in these areas. Given the fact that 40% of the world's crop yields are based on irrigation and almost half of this is from the basins of rivers originating in the Himalayas alone, effects of water scarcity can be an estimated reduction of the world food production by 1.5% by 2030 and at least by 5% in 2050 (UNEP, 2009).

The majority of the OIC member countries are located in dry areas with a relatively small portion of the world total water resources compared to their population and land area. The OIC member countries have 8397km^3 of renewable water resources, which represent only 15.3% of the world total renewable water resources (TRWRs). Agriculture sector is largely based on irrigation and currently accounts for 90% of total water consumption in these countries. At the OIC regional level, agriculture accounts for over 90% of total water consumption in South Asia and Latin America and Caribbean while this ratio is 70% to 80% in the rest of OIC regions.

The average renewable water resources per capita of the OIC member countries is about 5587 m^3/year, which is lower than the world average and significantly below the averages of some other regions like Europe, the Americas, Australia and New Zealand (Figure 2). Many OIC member countries are suffering increasing water scarcity as their TRWRs per capita are lower than the threshold level of 1700m^3/year. According to the FAO AQUASTAT (2007), 21 member states have TRWRs per capita less than 1700m^3/year. Among them, Pakistan, Lebanon, and Comoros experience water stress[2] while 18 member countries have water scarcity[3]. The majority of OIC countries suffering water scarcity are located in MENA region (16 countries). Over the years, OIC TRWRs per capita exhibited a declining trend and since 1992 decreased by 22.8%. MENA and SSA witnessed higher decline where TRWRs per capita decreased by 32% and 33%, respectively (SESRIC, 2009). Given the fact that water resources are already under great stress in the member countries and climate change will further exacerbate water availability in these areas, more member countries will face increasing water scarcity and subsequent decline in agriculture production.

Figure 2: Total Renewable Water Resources per Capita, 2007 (m^3/year)



Source: FAO AQUASTAT online database

[2] when TRWRs per capita per year is less than 1700m^3.
[3] when TRWRs per capita per year is less than 1000m^3.

Most of the OIC member countries have average precipitation depth less than 500m per year which shows high prevalence of aridity in these countries. Provided the fact that, precipitation provides soil moisture which is a crucial factor for the productivity of the crops, agriculture production will decline in majority of the member countries. Therefore, changing scenarios of precipitation level due to climate change will intensify the water scarcity in some OIC regions. These changes in precipitation will affect the levels of water storage in lakes and reservoirs, due to their higher sensitive to climate change. This could cause major problems for lakes, such as Lake Chad, which has already decreased in size by about 50% in the last 40 years. For the Niger River basin there is a predicted 10% change in precipitation, potential evaporation and runoff. In MENA, the average annual runoff will decline by as much as 27% by 2050. While with continuing increases in temperatures, water flow in the Euphrates may decrease by 30% and that of the Jordan River by 80% before the turn of the century. This will aggravate the water shortage problem and lead to more dependency on desalinated and treated wastewater (AFED, 2009).

Climate change induced variations in precipitation patterns will not only cause fresh water stress but will also trigger extremes weather events like floods, droughts, and land sliding. This will impact the fresh water supply as well as agricultural production. Sudan and Nigeria are highly vulnerable to climate change mainly due to persistent moisture deficit and widespread drought. While, the semi-arid rangelands in the Maghreb region countries Algeria, Morocco, and Tunisia are at high risk of desertification caused by increased aridity and widespread land degradation (Puigdefábregas and Mendizabal 1998).

According to the UN IPCC estimates (2007), increase in temperature could lead to the warming of ocean waters which may cause the sea level rise up to 59 cm by 2100 and even up to 5 meters if the melting of the glaciers and ice sheet Antarctica is taken into consideration. Sea level rise can seriously affect a number of OIC member countries especially in the MENA region where economic activities and agriculture sector are concentrated in the coastal areas which are highly vulnerable to sea level rise. As a result, in these areas sea water will damage the agriculture sector by increasing salinity of soil and contaminating the freshwater resources. Agriculture sector in Egypt will be highly vulnerable to the rising sea level and only one meter rise would put 12% of its agricultural land at risk. An elevated sea level will also exacerbate the flood impacts of the large rivers, especially the Niger and Nile. Some of the most vulnerable regions are the Nile delta in Egypt, the Ganges-Brahmaputra delta in Bangladesh, and the island of Maldives and Bahrain (AFED, 2009).

Climate change can also have a negative impact on agricultural land productivity by increasing the salinization of soil, nutrient depletion and erosion. According to the recent estimates of United Nation Environmental Program (UNEP, 2009), some 950 million hectares of salt-affected lands occur in arid and semi-arid regions, corresponding to nearly 33% of the potentially arable land area of the world. Globally, some 20% of irrigated land (450,000 km2) is salt-affected, with 2,500–5,000 km^2 of lost production every year as a result of salinity (UNEP, 2009).

According to the UN IPCC (2007), projected changes in the frequency and severity of extreme weather events are predicted to have more serious consequences for the agriculture sector and food production than changes in projected mean temperatures and precipitation. There will be potentially large negative impacts in developing regions compared to the developed countries mainly due to their higher reliance on agriculture, poor infrastructure and minimal capacity for the disaster management (Tubiello and Fischer, 2006). This will further aggravate already alarming food insecurity situation across the developing world.

Another major impact of climate change on the crops will come from intensification of pests like weeds, insects, and pathogens. Climate and weather conditions play an important role in the distribution and proliferation of pests. In addition, climate change also affects the efficiency of pesticides often used to control these pests by changing the conditions on the ground. For example, one of the most important factors which play a significant role in pesticide effectiveness, persistence, and transport is timing and volume of rainfall which induced by climate change will become highly uncertain in future.

According to the FAO report (2008), there is clear evidence that climate change is altering the distribution, incidence and intensity of animal and plant pests and diseases. Under the climate scenarios with more winter rain in the Sahel may provide better breeding conditions for migratory plant pests such as desert locust that are totally dependent on rain, temperature and vegetation, with catastrophic impacts on crop and livestock production. Pests and pathogens have had particularly severe effects on crop yields in the world's poorest and most food insecure region of Sub-Saharan Africa. They have been estimated to cause an annual loss of US$12.8 billion in yield of eight of Africa's principal crops, and may reduce yields in developing countries overall by around 50%.

Level of concentration of CO_2 in the atmosphere is another important variable which affect agriculture productivity through photosynthetic mechanism, where plant species vary in their response to CO_2, in part, because of differing photosynthetic mechanisms. Therefore, concentration of CO_2 in the atmosphere due to GHG emissions will certainly affect the crops and their productivity. However, so far the aggregate impacts of CO_2 concentration on agriculture sector are highly ambiguous as different crops show difference response to this phenomenon. Generally scientists are unanimous that an increase of atmospheric CO_2 levels can help to increase crop productivity in C3 crops like wheat, rice, and soybeans. However, the extent of the increase in productivity depends on many other factors like crop species and soil fertility conditions. On the other hand, productivity of the C4 crops such as sugar-cane and maize, which account for about one-fourth of all crops by value, will certainly decline (Celine, 2007). The positive impacts of elevated CO_2 on the crops are highly uncertain and depend largely on the associated impacts of high temperatures, changed patterns of precipitation, and possible increased frequency of extreme events such as droughts and floods, on the crop yields. Therefore, it's not very much clear that how much certain will be the beneficial effects of Carbon fertilization on global food production.

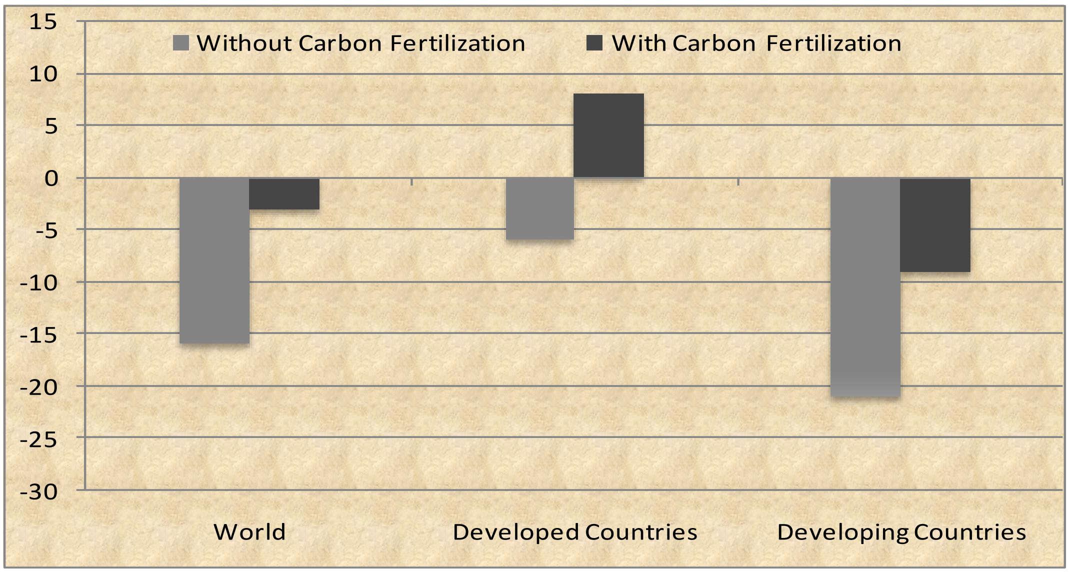
PROJECTED CHANGES IN AGRICULTURE PRODUCTIVITY

Keeping in view the negative impacts of climate change on agriculture sector, efforts have been made by many scholars to gauge the loss of productivity in this sector. Different climate models have been investigated and shown considerable variations in their findings, especially in short to medium term period (2030-2050). However, for the period after 2050, most of the models predicted substantial decrease in the agriculture productivity across the globe (UN IPCC, 2007).

Based on estimates of six climate models and two crop models, Cline (2007) investigated the country level impacts of climate change on agriculture production up to the end of this century using two important variables i.e. temperature and precipitation. As shown in Figure 3, by 2080, assuming a 4.4° C increase in temperature and a 2.9% increase in precipitation, the average agriculture productivity of the world (output per hectare) is expected to decrease by 16% without Carbon fertilization[4] and 3% with Carbon fertilization[5].

Although agriculture production is expected to decline globally, the impacts of climate change on agriculture productivity are projected to be unevenly distributed across the globe. In this respect, developing countries are expected to suffer more negative climate change impacts in terms of agricultural production losses than the developed countries. As shown in Figure 3, by 2080, the average agriculture productivity of the developing countries will decline by 9% with carbon fertilization and by 21% without carbon fertilization. In contrast, the average agriculture productivity of the developed countries is expected to experience a loss of 6% without carbon fertilization. Yet, if the elevated level of CO_2 in the atmosphere benefited the crops then agriculture productivity of the developed countries is expected to increase by 8%.

Figure 3: Projected Changes in Global Agriculture Productivity by 2080



Source: Adapted from Celine, 2007.

The impacts of climate change on agriculture sector in developing countries are also expected to be widely varied among different sub-regions, where the highest loss is expected to take place in Africa, both with or without Carbon fertilization. In contrast, expected losses in Asian region are lower than all other developing regions. As shown in Figure 4, Average agriculture productivity in Africa is expected to decline by 28% without considering carbon fertilization and by 17% if carbon fertilization is considered. Africa will be followed by Latin America with 24% and 13% loss with and without carbon fertilization, respectively, MENA by 21% and 9% and Asia by 19% and 7%. If

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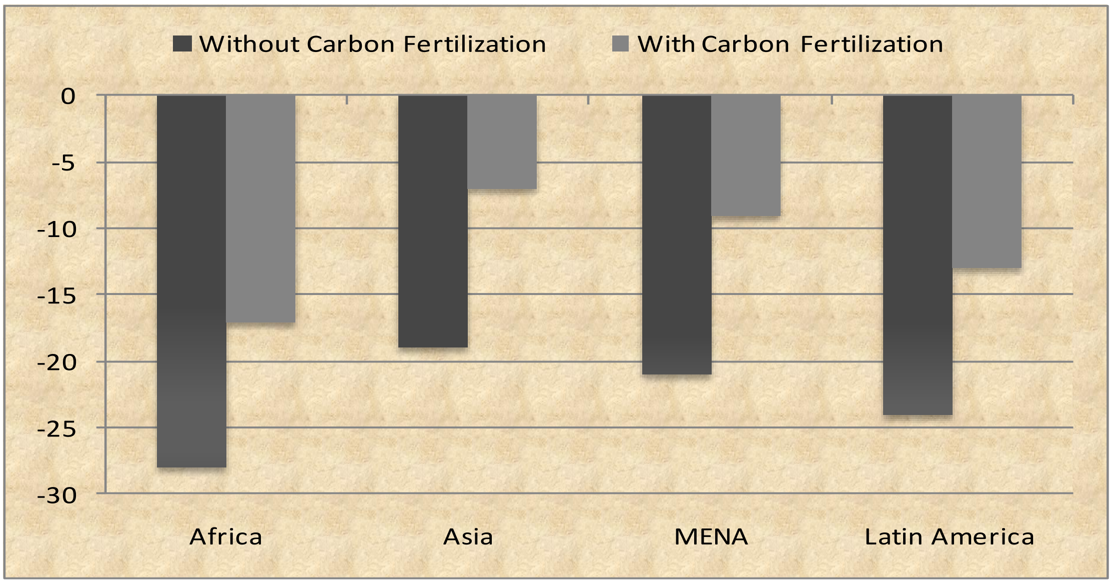
[4] If there are no beneficial effects of increased Carbon Dioxide (CO_2) on the production of crops.

[5] If some crops benefit from the increased Carbon Dioxide (CO_2).

there are no benefits of Carbon fertilization, then the most severely affected countries are expected to be in Africa, Latin America and Asia.

Figure 4: Projected Changes in Agriculture Productivity in Developing Regions by 2080



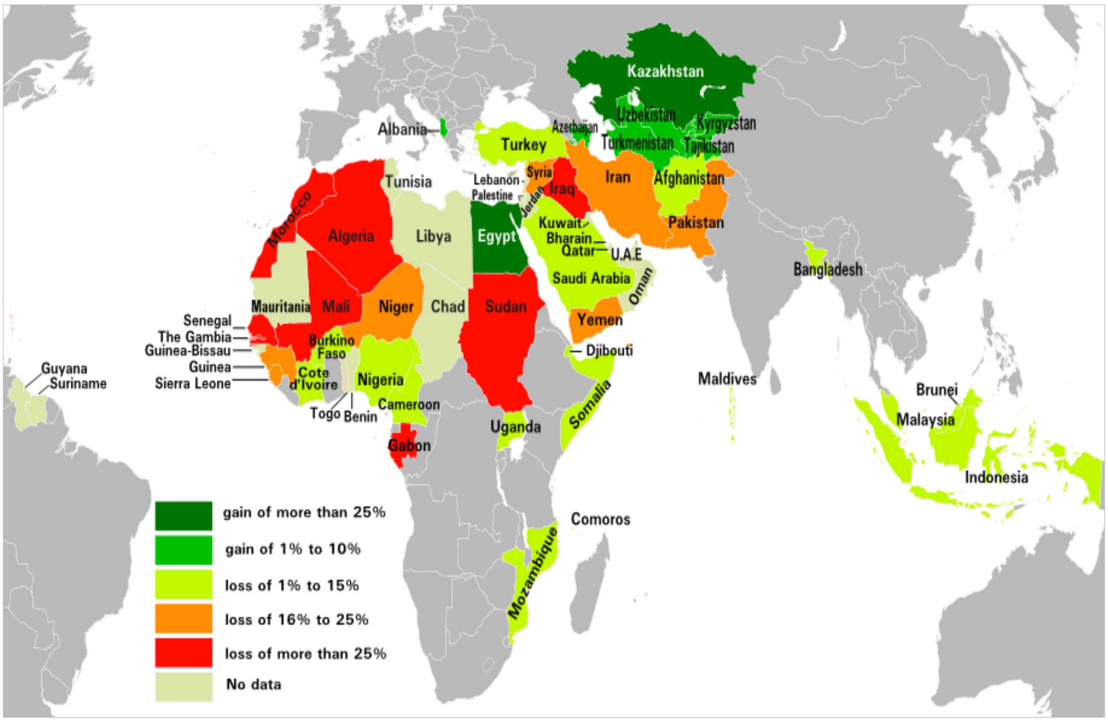
Source: Adapted from Celine, 2007.

In this analysis, 25 OIC member countries are included[6]. On average, agriculture productivity losses in these 25 OIC member countries are estimated at 25% without considering Carbon fertilization and 14% if Carbon fertilization is considered. At the individual country level, the highest decline is projected in the countries located in Sub Saharan Africa. Among these countries, Sudan and Senegal are estimated to record over 50% decline in agriculture productivity without carbon fertilization and over 45% with Carbon fertilization. In contrast, agriculture productivity of some OIC member countries in other regions is estimated to increase. For example, agriculture productivity in each of Kazakhstan and Egypt is estimated to increase by 11% without Carbon fertilization and 28% with carbon fertilization.

Assuming that Carbon fertilization will have positive impacts on crops, OIC member countries in Central Asia & Europe like Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan, Azerbaijan and Albania are expected to gain 1% to 10% increase in their agriculture productivity. Yet, OIC member countries in other regions are expected to suffer agriculture productivity losses despite the positive impacts of elevated carbon in atmosphere (Figure 5). For example, in South Asia, Pakistan is expected to experience a decline in agriculture productivity by 20%. The other OIC member countries in this region are expected to suffer lose of agriculture productivity by 1% to 15 %. Similarly, agriculture productivity losses in OIC countries in East Asia & Pacific region is estimated to decline by 1% to 15%.

[6] These member countries are Afghanistan, Algeria, Bangladesh, Burkina Faso, Cameroon, Egypt, Indonesia, Iran, Iraq, Kazakhstan, Malaysia, Mali, Morocco, Mozambique, Niger, Nigeria, Pakistan, Saudi Arabia, Senegal, Sudan, Syria, Turkey, Uganda, Uzbekistan and Yemen.

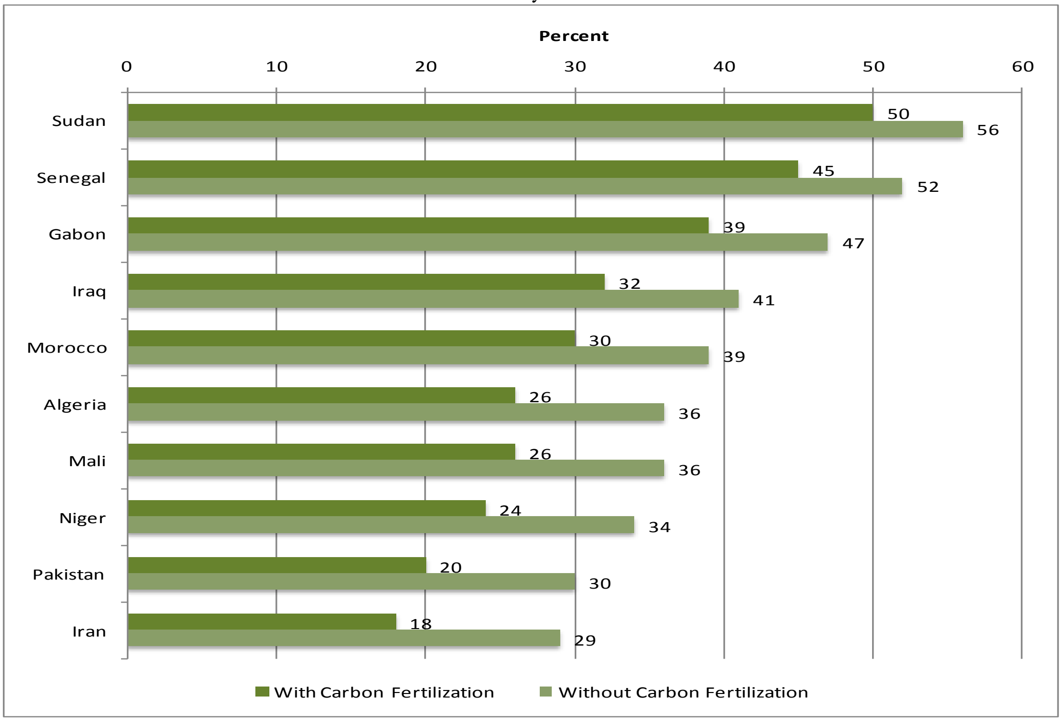
Figure 5: Projected Changes in Agricultural Productivity (with Carbon Fertilization) in OIC Member Countries by 2080



Source: Adapted from Cline, 2007.

In Middle East, Iran, Syria and Yemen are expected to suffer 18%, 16% and 17% loss respectively while for Saudi Arabia agriculture productivity loss is estimated at 10%. In this region, Iraq will be hard hit with agriculture productivity loss of 32%.In North Africa, agriculture productivity loss in Morocco and Algeria is estimated at 30% and 26% respectively (see Figure 6). In contrast, Egypt is expected to have agriculture productivity increase by 28%. Member countries in Sub-Saharan Africa will also experience negative impacts on agriculture productivity due to changes in climatic conditions. In this region Sudan, Senegal, Gabon and Mali are expected to suffer agriculture productivity loss by 50%, 45%, 39% and 26% respectively. Niger, Guinea, Guinea-Bissau and Sierra Leon could are expected to suffer agriculture productivity loss by 23% to 24% while in Burkina Faso, Mozambique, Cameroon, and Nigeria losses are estimated at 13%, 10%, 8% and 6% respectively. The lowest agriculture productivity loss in this region is estimated as 4% in Somalia and Uganda.

Figure 6: OIC Member Countries with Highest Expected Agriculture Productivity Loss by 2080



Source: Adapted from Cline, 2007.

The expected negative impacts of climate change on agriculture productivity will be a major reason for the expected increase of undernourishment in the coming decades. Studies show that in 2080 around 1.3 billion more people could be at risk of hunger under the most extreme climate change scenario, with the poorest countries worse affected (Slater. R, 2007). It is also estimated that projected impacts of climate change on agriculture sector by 2080 will cause global agricultural GDP to decrease by 1.5%. The agriculture GDP of the developing countries is projected to decline on average by 1.9% compared to 0.5% in that of the developed countries. Among the developing regions, agriculture GDP is estimated to decline by 4.9% in Sub-Saharan Africa and by 4.3 % in Asia (FAO: Climate Change, Water and Food Security).

CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

Recent trends and studies indicate that changing climatic patterns in the coming decades will cause negative impacts on agriculture production, particularly food production. It is then clear that coherent strategies are needed to facilitate the adaptation of agriculture and cropping systems to climate change through better management of crop species and varieties. Agricultural diversification and development of climate-resilient crop varieties will be necessary to help farmers to adapt to the changing weather conditions. Improvement in ways of transmitting information about crop variety adaptation both through market and non-market channels are needed as well. These approaches will require countries to develop policies to ensure effective development and transfer of new crop varieties through effective and improved seed supply systems.

OIC member countries are highly vulnerable to the impacts of climate change mainly due to its negative impacts on their agricultural production. Provided the fact that agriculture sector is of paramount importance for the economic development and eradication of poverty and hunger in many member states, there is an urgent need to take necessary steps to minimize/eliminate the negative impacts of climate change on this sector by employing coherent agriculture policy both at the national and intra-OIC cooperation level. In this context, the following broad measures could be recommended:

- In order to mitigate the negative impacts of climate change on the agriculture sector, there is a need to put the agriculture sector back at the top of national development agendas. Because over the years, mainly due to structural transformation programs and strategies, agriculture sector has been generally neglected compared to other sectors both at national and international level. Consequently, the share of agriculture in public expenditures has declined across the developing countries, including some OIC member countries. Meanwhile, the share of Official Development Assistance (ODA) for the agriculture sector has also witnessed continuous decline.

- In the majority of the OIC member countries, especially in Sub-Saharan Africa, agriculture crops which are usually being cultivated will not be able to bear the stress of climatic changes and their productivity will decline significantly. Therefore, there is a need for improving the quality of the seeds and cropping systems in these countries. Both at the national and intra-OIC cooperation levels, member countries should establish agriculture research funds to encourage development of climate-resilient crop varieties which are heat and drought-resistant. Member countries should also encourage and promote climate-friendly agricultural production systems and land-use policies.

- The majority of the OIC member countries located in arid and semi-arid dry regions and their share in global renewable water resources is only about 15%. Climate change and extreme weather conditions may require large water storage facilities and modern irrigation systems and techniques. Therefore, there is a need to promote and encourage both public and private sector investments in new water-save irrigation systems and water management infrastructure, proper water storage and control facilities like dames and ponds. To this end, intra-OIC investment in the agriculture sector should be also enhanced and encouraged through improving investment and business environment in the targeted agriculture-based OIC member countries.

- Efforts should be made to facilitate the appropriate access to finance for small farmers in rural areas in member countries through enhancing the "micro finance systems" in these countries and providing them with improved seeds and crop varieties that help promote climate risk management and adaptation and fertilizers. Efforts should be also made to encourage and promote practices of sustainable agriculture by helping and educating the farmers best techniques including improving yields on marginal land, farming forests, expanding aquaculture, rediscovering forgotten foods, and encouraging urban agriculture.

- Climate change has increased the intensity of natural disasters like floods, droughts and cyclones which are causing severe damage to agriculture sector and posing severe threats to the very survival of millions of people across the OIC member countries. Hence both at national and intra-OIC cooperation levels, member countries should develop and adopt an emergency response mechanism to minimize the impacts of such disasters by providing necessary help.

- There is also a dire need to establish research facilities to revolutionize the process of data collection, dissemination, and analysis to predict the impacts of climate change in general and finding the regions where the effects will be greatest. Availability of accurate data will help to overcome the uncertainties regarding the impacts of climate change and encourage the governments to formulate relevant policy measures. To achieve this goal, member countries should collaborate with climate and environment related regional and international agencies to develop their national and regional climate change monitoring facilities.

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Statistical, Economic and Social Research and Training Centre
for Islamic Countries (SESRIC)

Attar Sokak No. 4, 06700 GOP, Ankara, TURKEY
Tel: (90-312) 468 6172 (4 lines) Fax: (90-312) 468 5726
E-mail: oicankara@sesric.org Web: www.sesric.org