# Effects of Climate Changes on Future Architecture and the Contribution of the Developing Countries to Limit and Avoid Harms

## "The Arab World – A Case Study"

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## Abstract:

Climate changes represent the most significant challenges that threaten the future of humanity in the beginning of the twenty-first century. This portends disastrous consequences on the future generations, unless we start correcting the path, limiting the effects and avoiding harms. Construction industry is considered to be one of the greatest causes of worsening the problem. Therefore, architects must hurry towards providing a new architecture that is capable of facing climate changes under the growth of requirements and the decrease of capabilities; exhaustion of non-renewable natural resources is the most prominent example. These non-renewable natural resources are wasted in a terrified acceleration through the current patterns of architecture that do not put the reuse as an inevitable necessity to face the climate changes and the depletion of resources. Moreover, the most effective problem is the failure of architects, including those who are interested in environment, to evaluate the final product without taking the manufacturing stages, that are considered to be one of the most dangerous and the greatest causes of the greenhouse gases emissions, into consideration.

Therefore, the research paper comes as a serious trial to present a sort of architecture that is capable of facing the challenges of future, and the challenge of the ramifications of environmental deterioration, as the non eco-friendly construction industry represents one of the most important causes of them. Modern studies asserted that the current construction industry causes 33 % of carbon dioxide emissions; in addition, it depletes about 17 % of fresh water; and it consumes about 25 % of wood; beside the use of about 40 % of the produced energy. But the most important and serious thing consumed by the current construction industry and that cannot be recouped are the non-renewable natural resources that the construction industry exhausts from them about 50 % of the amounts of the annually extracted natural resources. This means that creating an architecture that adopts recycling these natural resources is a very important matter.

Although the developing countries do not contribute by a great deal to the emissions of greenhouse gases, they bear the greatest portion of climate changes consequences. For example, the contribution of the Arab World does not exceed 5 % of greenhouse gases, but the Arab World bears the costs of the environmental deterioration by a rate that ranges from 4 % to 9 % of the local production. The Arab area is one of the most areas in the world that is affected by the harms of climate changes because the expansion of its coasts; this exposes it to the danger of the rise of sea water level. In addition, to the increase of temperature by a rate that ranges between 2 degrees and 5.5 degrees, the matter that will affect the rates of rains that may decrease by a rate of 20 %, the matter that will lead to the rise of drought levels in an area whose water resources level are very few. This requires changes of the future architecture that is represented

DOI: 10.21608/mjaf.2020.26108.1545

in creating designs that are more capable of adaption to its environment beside decreasing water consumption and recycling water; in addition to the necessity of evaluating the manufacturing stages of the construction materials as a main condition for the evaluation of buildings sustainability; in addition to a group of political decisions that the developing countries should make to limit climate changes.

## Key words:

Climate changes – environmental deterioration – future architecture – natural resources

## Preamble:

The mid of the nineteenth century is considered to be the launching point towards the environmental deterioration. With the beginning of the industrial revolution and the radical changes in the human activities, from the manual activities to machinery, the human activities required the consumption of fossil fuel, in conjunction with the urban expansions and deforestation. This led to the increase of emissions in quantities that exceed the environmental capability to bear; consequently, the concentration of greenhouse gases in the atmosphere. The concentrations of carbon dioxide have been increased from 280 parts of million in the pre-industrial era to 430 parts of million with the beginning of the twenty first century. It is expected that it will reach 550 parts of million by 2035. This means the increase of the international temperature by two Celsius degrees. Moreover, the mid of the twentieth century witnessed an aggravation of the environmental deterioration with the invention of chlorofluorocarbon (CFC) that is considered to be the main cause of the Ozone layer hole, above the South Pole, whose area has been widened to equal the area of the continent of Australia according to the American Aviation and Space Agency (NASA) in 1985. If the current industrial policies, the increased use of fossil fuel, and the excessive use of the chlorofluorocarbon gas (CFC) continued, temperature may rise by 5 Celsius degrees. This disastrous increase can be brought closer to minds by the information that the current climate is warmer than the latest Ice Age that prevailed Earth for more than ten thousand years by 5 Celsius degrees. The increase of temperature degrees of oceans leads to ice melting, and then the increase of the levels of oceans and seas by an approximately rate of 59 cm by 2100, according to the evaluations of the reports of the International Governments concerned with the changes of climate in 2007. This increase may reach 5 meters in the case of the melting of a part of the ice sheet in the South Pole Continent, especially that this sheet was decreased in 2009 by a rate of 53 % after the highest level that it reached in 1980, the matter that forebodes the increase of sea levels in a manner worse than what is expected.(1)

Therefore, humanity must take actions towards facing the causes of climate changes. Although the dangers of climate changes have a great attention of most scientists, the data and predictions of climate changes still ambiguous for many non-specialists; this leads to the adoption of the policy of suspicion from the part of most of the developing countries and ignorance from the part of most of the developed countries; the matter that increases the probability of the increase of temperature for more than 5 degrees during the following decades reaches 50 % at least. Although all studies asserted that the main cause of the emissions of greenhouse gases is the combustion of fossil fuel to get energy, the developing countries still go with slow paces towards clean energy with the absence of the financial and technological support from the developed countries. Arab countries are included in these developing countries. Although the

dangerous effects of the climate changes on the Arab countries, their efforts are still very little in the contribution of procedures to limit the climate changes on the levels of all fields such as waste management, industry and infrastructure, in addition to the sustainable construction and design that still in their initial stages of development. In the few little past decades, the urbanization model in the Arab world, especially in the Golf Area, is characterized by architectural models that are exported from the west. These models are far from the compatibility with the social, geographical and climate conditions of the Arab countries. The skyscrapers that most of their frontages are covered with glass became the distinguished characteristics of the new urban centers like Abu Dhabi, Dubai and Doha, the matter that requires an enormous amount of electricity for air conditioning; this means more combustion of energy and more greenhouse gases.(2)

## Research Controversy:

The urgent need for development and achieving economical growth rates that motivate humans to burn more fossil fuel which is cheaper to get the energy required for increasing manufacturing, under the conviction of most politicians that there is no need of prompt costs to achieve future benefits, leads not only to the continuity of the environmental deterioration, but also to the aggravation of this deterioration, the increase of its size and widening its disastrous effects. Here, the research controversy exists to find the solutions that maintain the rights of countries, especially the developing countries, to continue the development and achievement of the economical growth, and maintain environment from deterioration by prohibiting the climate changes or decreasing their intensity and their accelerating pace.

## Research Hypothesis:

The research assumes that adopting stimulation methods achieves greater results than methods of prohibition or imposing penalties; it includes all the levels participating in the architectural production, including architects, civil community, decision makers and policy makers.

## Research Objectives:

The research aims at achieving a group of main objectives and sub-objectives that are represented in the following:

## Main Objectives:

1- Motivating architects to use the green techniques and the eco-friendly designs available in the contemporary era.

2- Directing researchers to do more future researches to face climate changes and limit their effects.

## Sub-Objectives:

1- Warning the rulers and the decision makers in the developing countries against the dangerous effects of climate changes.

2- Motivating economists and businessmen to contribute to the limitation procedures to avoid the harm on the economical growth.

3- Informing the community about the importance of calling for an architecture that will be considered to be less-originator of climate changes and that will be capable of adapting to its surrounding environment.

## Research Methodology:

The research adopted two principal approaches to represent the research controversy and to achieve the research objectives; the approaches are:

***Descriptive Approach:*** through describing the real situation and monitoring the results proved by the modern studies related to climate changes.

***Deductive analytical Approach:*** through analyzing data and reviewing the future perceptions.

## 1- Effects of Climate Changes on the Developing Countries:

Climate changes represent a danger that threatens the survival of humanity, as their effects influence all human life aspects, starting from human health, food production, natural environment and constructed environment, including economy. Economists and the demanders of the countries' rights of development, see that climate changes harm economy, as studies asserted that the environmental deterioration costs exceed the economical growth rates, as a contradiction of the rulers' prevailing belief that the procedures that decrease climate changes hinder the processes of development and economical growth. This is contradicted by all the modern studies and researches that asserted that for each increase in the international temperature rates by one Celsius degree, the economical growth decreases by a rate that ranges from 2 % to 3 %. The World Economic and Social Survey issued by the United States in 2009 estimates the costs of decreasing the effects of the climate changes by only 1 % of world total production; and it is considered to be a little rate, if compared to the costs and dangers of the effects of the climate changes. Moreover, the studies asserted that in the case of ignoring the warnings against the dangers of the effects of climate changes, the world economic losses may reach 20 %; and the more disastrous crisis will remain, as the feeling of the climate changes effects will be more serious on the developing countries that have the less technological and financial capabilities to overcome the problems and adapt to.(3) Furthermore, Most developing countries basically exist under the water poverty line. This means that the increase of temperature leads to disastrous results. The most affected Arab countries are the Arab countries that exist in an area of high drought, the matter that raises the necessity for taking decisive actions towards decreasing the severity of climate changes.

Although the developing countries have little contributions to climate changes, they are the most exposed countries to the dangers of climate changes. For example, the emissions produced by the Arab countries - that most of them are considered to be developing countries – do not exceed the developmental activities in all the Arab countries; these emissions represent 5 % of the world emissions total (Figure 2). But the Arab World bears the greatest share of the disastrous effects of climate changes. The cause of this is that water resources in the Arab World are very rare and the temperature is very high. The modern studies asserted that the area of the Arab World witnesses during the period from 1970 to 2004 an increase between 0.2 to 2 Celsius degrees. The increase of temperature is directly related to the increase of the evaporation rate. What increases the worseness of situation is that the Arab area exists in the area of the least water resources; the matter that represents a danger on the natural and physical systems. The African countries have the same situation and destination of the Arab countries. The total emissions of the African countries are 4 %; and also the countries of Central America and the Caribbean countries whose total emissions are 2.5 %.

Moreover, the increase of sea level will lead to the coastal urban destruction in several developing countries that do not have the financial or technical capabilities to face these dangers, including the Arab countries whose coasts extend along 34 thousand kilometers, 18 thousand kilometers of which are inhabited by people. The agricultural sector and the humid lands will be affected, in addition to the decrease of the total area of the country. In the case of the increase of the sea level for 1 meter, Egypt will lose about 12 % of its most fertile agricultural lands in the Nile Delta; while this rate may reach 22 % if the worst scenario happens which is the increase of sea level for five meters. In the case of the first scenario, Qatar will lose 22 % of its humid lands; and this rate may reach 75 % in the case of the second scenario. Other countries like Tunisia and Emirates will lose whole cities. In the case of the first scenario, Mauritania will lose about 6 % of its urban areas; this rate may reach 30 % in the case of the second scenario. (4) illustrates the predictions of the increase of the sea level. Generally, more than 50 developing countries all over the world will not be responsible for more than 1 % of the emissions of the greenhouse gases.(5)

## 2- Contribution of Architecture in Climate Changes:

Construction industry is considered to be the most contributing industry of emissions and consumption of energy, water and raw materials. Construction industry causes 33 % of Carbon dioxide emissions; and it consumes 50 % of raw materials and 40 % of energy; in addition to exhausting 25 % of wood and 17 % of water. This makes architecture at the head of the list of the fields causing climate changes. Therefore, the most significant demands and procedures to enable the countries of the world to keep the rates of the atmosphere components, especially the greenhouse gases, in the allowed levels are the necessity that the developed countries should support the developing countries in several fields, the most important of which are the orientation towards clean energies, rationalization of water consumption and recycling it and limiting the use of raw materials; they are the fields that are directly related to architecture. Thus, the principal world controversy in the twenty-first era is the equation of balance between the human needs for development in order to meet the accelerating human demands, and between maintaining the environment and achieving sustainability for the future generations.

Therefore, the calls for the necessity of limiting manufacturing and decreasing the rates of greenhouse gases emissions do not receive the desired feedback. Hence, we must find more realistic alternatives capable of achieving the lost balance; this could be achieved by the motivation alternatives and not the decrease alternatives because the emissions of greenhouse gases became a reality that is difficult to limit it but we can get rid of it and decrease its effects.

## 3-Future Architecture under Climate Changes:

From the above, the disastrous effects of climate changes on the future of humanity and the close relation between architecture and climate changes are clear. This motivated architects to do more researches in this field. It did not stop at research, it extended to experiment towards an architecture that is more compatible with its environment. One of these most prominent experiments is Masdar city in Arab Emirates, that is considered to be the first city that does not cause carbon emissions and waste productions and it is free of cars. It was planned to have a capacity for 40 thousand persons, and to receive other 50 thousand during work periods to do their works in the Free Technological Zone that has the capacity of 1500 companies and research centers with future visions. Movement is via fast and public transportation systems

related to railway lines that connect the inside of the city to its outside. The absence of cars allowed the construction of narrow roads with shades to decrease air temperature; this limits the energy consumption instead of cooling air by air conditioners. Directing is taken into consideration, in addition to the use of solar cell sheets to produce clean energy to provide buildings and water treatment plants, in addition to recycling gray water.([6]) This makes Masdar City a unique and leading experiment. In spite of the merits and positives that are taken into consideration in Masdar City, there is a problem now that most the architects and planners that are interested in the sustainable designing and the future architecture which is the false prevailing belief that the eco-friendly technology and the natural raw materials accomplish an architecture that is compatible with its environment, while these facts are not as they appear of positive impressions. As the judgment about the construction materials is determined through its final interaction with environment, neglecting the interaction of manufacturing stages with the environment or the effects of extracting, transporting and manufacturing the raw material from which these materials are manufactured. For example, many architects believe that building a house from wood represents an eco-friendly house because the raw materials that are used in it are natural materials that do not harm environment, if compared to other materials such as cement and iron. But in reality, building this house required cutting down many trees that are considered to be the real lungs of the planet and which help it get rid of Carbon dioxide and produce oxygen. Therefore, manufacturing this house without the commitments of planting alternative spaces instead of the forests that were removed is considered to be a harm of the environment and an attribution to the acceleration of climate change rates.

This is what this research paper tries to shed light on as a main criterion to evaluate the compatibility of architecture with its environment. Evaluation should not be limited to the final product, but it should include the stages of extracting the raw materials, manufacturing and transportation, then the final assembly, and finally the stage of operation and demolition.

Moreover, the consumption of resources without the guarantees of the sustainable use is considered to be one of the prominent contemporary architecture problems that should be limited, in addition to searching for green solutions for the problems and challenges that face the contemporary architecture and limit its speed of converting to a more compatible architecture with its environment in the sustainability framework and accomplishing the requirements of the contemporary generations without decreasing the resources of the future generations.

Based on the above, future architecture should take a group of considerations that should be achieved in the designs, in addition to the issuance of a group of political decisions, in a manner that guarantees the accomplishment of the sustainable use of resources and limits the negative effects of the manufacturing stages; in addition to the self-ability to produce energy and food and the reuse of the construction materials with treatments compatible with their environment that contribute to the orientation towards an architecture that is capable of adapting to the climate changes and future challenges.

## 4- Contribution of the Developing Countries to Limit and Avoid Harms:

Achieving the ideas and visions of the future architecture is not limited to the extent of efficiency of the architectural or urban designs of the cities and the ability of applying them; they should be followed by a group of political and economical decisions supported by both

developing and developed countries. It is important to overcome the obstacles of limiting the climate changes; most of these obstacles are caused by political convictions that represent the main cause of the inability to decrease the climate changes, as all the developing and developed countries have motivations for not being restricted by any agreements concerning limiting the emissions of the greenhouse gases; while the developing countries do not want to put restrictions on their economical growth, the developed countries refuse to bear alone the costs of decrease. This dilemma represents the most difficult obstacle on the way of the trials to stop the climate changes or to decrease their effects. Although the trivial contribution of the developing countries in the climate changes, and their lack of technological or financial ability to decrease their effects, they are the most affected areas by the consequences. Furthermore, the inequality of the standards of living and the income rates greatly contributes to the increase of contribution to the harms resulting from the excessive consumption of resources. Therefore, because the developing countries are the most affected places by climate changes, it is necessary that they should issue these political and economical decisions in the light of a clear and inclusive vision that is directed to all the fields causing the climate changes, starting from the field of using the clean energy that does not exceed 7 % of the energy that the Arab World can produce, to encouraging the manufacturing of the devices that save energy; starting from the light lambs that it is proved that they consume 19 % of the world production of electricity and they cause the emissions of 1.9 billion tons of carbon dioxide annually. Furthermore, encouraging the conversion to the use of the fossil fuel alternatives has a great effect in changing the referential scenarios. Converting from using the petroleum products to using the natural gas in some Arab countries led to avoiding the emission of 900 thousand tons of carbon dioxide. This asserts that we can adjust the disastrous expectations that appeared in the report of the Club of Rome (Limits of Growth) if we followed the strategies of conversion and rationalization. The most important fields that through developing them it is possible to limit the climate changes and avoid harms are transportation, industry, energy and wastes. Adding improvements to these fields can limit the climate changes. All these fields are directly related to architecture that can be developed to contribute to the limitation of climate changes and to contribute to the improvement of the efficiency of these fields to decrease the emission rates of the greenhouse gases through the following improvements Transportation, Industry, Energy and Wastes.

## References:

1-Tolba, Mostafa Kamal w A5roon “Athar ta8er almana5 3la Al beldan Al 3rabia “el Montadah Al2rabi ll be2a w Altanmeh-2009

2- Tolba, Mostafa Kamal w A5roon “Ta7deat almosta2bal” El Montadah Al3rabi ll be2ah w Al tanmyah-2008

3-Sadek, 3bd El krim, w a5roon,” Al 2mn al ghza2y “El Montadah Al3rabi ll be2ah w Al tanmyah-2014

4-Sa3b, Nagib “Al basma al be2eah fi Al beldan Al 3rabiah” El Montadah Al3rabi ll be2ah w Al tanmyah-2012

5- Ts3det, Bosab3en- “Athar ta5er almana5 3la al 2ktsad w Al tanmyah al mstadamah “Al moltaka al watani al2wal 7awl albe2h w al tanmeh al mostadamah _ Gam3t Al bwerh-2013

6-Raafat, Ali “3marat al most2bal “markz ab7ath enter conselt-2007

7-Moslem, Ayman “Al tatbe2AT Al 5dra kmd5al ll 2stdama” M2tmar Al 2skan Al 3rbi Al 2wal ,Al kahera, Mars 2010

8- Magalia Albena2 Al 3rabi –Al3dad Al Sab3-2006

9-Al Sayed, Mona Rezk Gad “Mafhoom Al Mabani Al Motanfsah l mwagaht Al tagher Al Mana5y “Rsalet Magster kolyat Al Handash, Gam3et Al kahera, 2015

10-Hamoda, Shref Salah Al din Abdall, Altaghyrat Al Mna5ya w ta2therha 3la Al takhtit w Al tsmem Al be2i 3la Al Mostawa Al Mahli w Al 3almy “Rsalet Magster kolyat Al Handash, Gam3et Al kahera, 2014

11- Al Hoity, Eman Mohamed “Dar Al 3mara Al be2ea Al mostadama fi Al tasmem Al Da5ly ll montaged Al se7ya “magalet Al 3mara w alfnon w Al 3loom Al 2nsanya, Al glade 3 Al 3dad 12, 2017

12-https://link.springer.com/article/10.1007/s11625-007-0032-y

13-Sergio Altamonte Climate Change and Architecture: Mitigation and Adaptation Strategies for a Sustainable Development Journal of Sustainable Development - February 2009

1- 14-https://mostaqbal.ae/european-city-set-to-transform-industrial-site-into-remarkable-vertical-forest/