

The management of water resources to address the impacts of climate change – adaptation and mitigation-

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Abstract : warming over several decades has been linked to changes in the large-scale hydrological cycle such as: increasing atmospheric water vapour content; changing precipitation patterns, intensity and extremes. The impacts and effectiveness of the climate mitigation and adaptation policies depend on the proper assessment of climate change, for that the Adaptation options designed to ensure water supply during average and drought conditions require integrated demand-side as well as supply-side strategies. Also, the Mitigation measures can reduce the magnitude of impacts of global warming on water resources, in turn reducing adaptation needs.

Key words : Impacts , climate change, management of water resources , Adaptation , Mitigation.

ملخص:

عمدت مختلف الدراسات العلمية على ربط تدهور الثروة المائية في العالم بظاهرة التغيرات المناخية على نطاق واسع مثل: زيادة محتوى بخار الماء في الغلاف الجوي. تغيير أنماط هطول الأمطار وكثافتها. تعتمد الآثار وفعالية سياسات التخفيف المناخ والتكيف معه على التقييم السليم لتغير المناخ، لذلك من خيارات التكيف حلول تهدف إلى ضمان وفرة المياه خلال حالات الجفاف، وهذا يتطلب إدماج جانب إدارة وتسيير الموارد المائية فضلا عن ضرورة وضع الاستراتيجيات المناسبة في جانب العرض. كما يمكن لتدابير التخفيف أن تقلل من حجم آثار ظاهرة الاحتباس الحراري والتغيرات المناخية على الموارد المائية. الكلمات المفتاحية: الآثار، تغير المناخ، الموارد المائية، إدارة الموارد المائية، التكيف والتخفيف.

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The introduction

The climate change which the world confronts today constitute an important challenge because of the effects of global warming in different fields, moreover, the problem of misusing the natural resources and the decline of the environment has a big impact on weakness of sustainable development. These challenges have pushed the world countries to seek for alternative to protect environment.

Understanding the impact of climate change on the economy's performance has become an important issue for developed and developing economies. The Intergovernmental Panel on Climate Change (IPCC) in its fourth assessment report said that, the changes in atmospheric concentration of GHGs and aerosols, land cover and solar radiation alter the energy balance of the climate system and are drivers of climate change. Also the continuous increase in concentration of GHGs in the atmosphere is likely to lead to climate change resulting in large changes in ecosystems, leading to possible catastrophic disruptions of livelihoods, economic activity, living conditions, and human health.

The economic impacts and effectiveness of the climate mitigation policies depend on the proper assessment of climate change impact on the economy. In the context of GHG emissions as well as climate change impact on the economy, different national and international institutes as well as environmental economists are forging together to undertake scientific studies to decide on a proper framework for impact analysis. The multiple impacts of climate change on biodiversity will mean less environmental sustainability, not more. The message is clear: if climate change is not halted, the Millennium Goals will simply not be achieved, **The aim of this research** is to give a review about, the principal effects of climate change on water resources and how we can address it. thus, **the fundamental question** is: how the climate change affects water resources, and what are the alternative for adaptation and mitigation?

To answer this principal question, we have divided them into several axes which are:

- **The Climate change;**
- **What will be affected in futur ?**
- **Management of water resources: Adaptation and mitigation to the impacts of climate change;**

1. The Climate change and its causes

1.1. The Definition of climate change

Climate change is when the average long-term weather patterns of a region are altered for an extended period of time, typically decades or longer. Examples include shifts in wind patterns, the average temperature or the amount of precipitation. These changes can affect one region, many regions or the whole planet.¹

1.2. What are the causes of climate change?

The principal causes of climate change are:²

- Natural processes such as volcanic eruptions, variations in Earth's orbit or changes in the sun's intensity are possible causes.
- However, humans activities can also cause changes to the climate for example by creating greenhouse gases emissions or cutting down forests.
- Global warming and the climate changes seen today are being caused by the increase of carbon dioxide (CO₂) and other greenhouse gas emissions by humans.
- Human activities like the burning of fossil fuels, industrial production, etc. increase greenhouse gas levels. This traps more heat in our atmosphere, which drives global warming and climate change.

Then; The Climate change' refers to a change in the state of the climate its may be due to internal processes and/or external forcings. Some external influences, such as changes in solar radiation and volcanism, occur naturally and contribute to the total natural variability of

¹ Allison, Ian. The science of climate change: questions and answers. Canberra: Australian Academy of Science, 2010.

²UNESCO/UNEP. Climate Change Starter's Guidebook: An issues guide for education planners and practitioners. Paris: United Nations Educational, Scientific and Cultural Organization and the United Nations Environment Programme, 2011.



the climate system. Other external changes, such as the change in composition of the atmosphere that began with the industrial revolution, are the result of human activity. Scientists now know for certain that human activities, mainly the burning of coal and oil, have dramatically increased concentrations of heat-trapping gases in the atmosphere, which are causing the observed warming, and it will continue to warm the planet for several centuries.

2. What will be affected in futur ?

2.1. The impacts of climate change

Climate change is already causing:¹

- Greater strength of extreme weather events like: heatwaves, tropical cyclones, floods, and other major storms.
- Increasing number and size of forest fires.
- Rising sea levels (predicted to be as high as two feet by the end of the next century).
- Melting of glaciers and polar ice.
- Increasing acidity in the ocean, resulting in bleaching of coral reefs and damage to oceanic wildlife.

2.2. The impact of climate change on water resources

The consequences of climate change may alter the reliability of current water management systems and water-related infrastructure. While quantitative projections of changes in precipitation, river flows and water levels at the river-basin scale are uncertain, it is very likely that hydrological characteristics will change in the future. Climate model simulations for the 21st century are consistent in projecting precipitation increases in high latitudes (*very likely*) and parts of the tropics, and decreases in some subtropical and lower mid-latitude, and By the middle of the 21st century, annual average river runoff and water availability are projected to increase as a result of climate change, at high latitudes and in some tropical areas, and decrease over some dry regions at

¹ <http://whatsyourimpact.org/climate-change-greenhouse-effect>, consulté le 21/3/2015 à 21:00.

mid-latitudes and in the dry tropics Increased precipitation intensity and variability are projected to increase the risks of flooding and drought in many areas Water supplies stored in glaciers and snow cover are projected to decline in the course of the century Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution Globally, the negative impacts of future climate change on freshwater systems are expected to outweigh the benefits Changes in water quantity and quality due to climate change are expected to affect food availability, stability, access and utilisation.

3. Management of water resources: Adaptation and mitigation to the impacts of climate change;

Water managers have long dealt with changing demands for water resources. To date, water managers have typically assumed that the natural resource base is reasonably constant over the medium term and, therefore, that past hydrological experience provides a good guide to future conditions. Climate change challenges these conventional assumptions and may alter the reliability of water management systems, Management responses to climate change include the development of new approaches to system assessment and design, and non-structural methods through such mechanisms as the European Union Water Framework Directive It is possible to define five different types of limits on adaptation to the effects of climate change.

- (a) **Physical or ecological:** it may not be possible to prevent adverse effects of climate change through either technical means or institutional changes. For example, it may be impossible to adapt where rivers dry up completely.
- (b) **Technical, political or social:** for example, it may be difficult to find acceptable sites for new reservoirs, or for water users to consume less.
- (c) **Economic:** an adaptation strategy may simply be too costly in relation to the benefits achieved by its implementation.

- (d) **Cultural and institutional:** these may include the institutional context within which water management operates, the low priority given to water management, lack of co-ordination between agencies, tensions between different scales, ineffective governance, and uncertainty over future climate all act as institutional constraints on adaptation.
- (e) **Cognitive and informational:** for example, water managers may not recognise the challenge of climate change, or may give it low priority compared with other challenges. A key informational barrier is the lack of access to methodologies to cope consistently and rigorously with climate change.

Climate change poses a conceptual challenge to water managers by introducing uncertainty in future hydrological conditions. It may also be very difficult to detect an underlying trend, meaning that adaptation decisions may have to be made before it is clear how hydrological regimes may actually be changing. Water management in the face of climate change therefore needs to adopt a scenario-based approach. This is being used in practice in countries such as the UK (Arnell and Delaney, and Australia). However, there are two problems. First, there are often large differences in impact between scenarios, requiring that analyses be based on several scenarios. Second, water managers in some countries demand information on the likelihood of defined outcomes occurring in order to make risk-based decisions.

Conclusion

Economics has much to say about assessing and managing the risks of climate change, and about how to design national and international responses for both the reduction of emissions and adaptation to the impacts that we can no longer avoid. If economics is used to design cost-effective policies, then taking action to tackle climate change will enable societies' potential for well-being to increase much faster in the long run than without action; we can be 'green' and grow. Indeed, if we are not 'green', we will eventually undermine growth, however measured.

- Climate change affects the function and operation of existing water infrastructure – including hydropower, structural flood defences, drainage and irrigation systems conditions.
- Water resources management clearly impacts on many other policy areas, e.g., energy, health, food security and nature conservation. Thus, the appraisal of adaptation and mitigation options needs to be conducted across multiple water-dependent sectors
- There is a need to improve understanding and modelling of climate changes related to the hydrological cycle at scales relevant to decision making.

Adaptation to climate change in developing countries is vital and has been high lighted by them as having a high or urgent priority. Although uncertainty remains about the extent of climate change impacts, in many developing countries there is sufficient information and knowledge available on strategies and plans to implement adaptation activities now. However, developing countries have limitations in capacity making adaptation difficult. Limitations include both human capacity and financial resources light of sustainable development, the integration of adaptation into policy and development planning, and the need for further capacity-building and training.

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