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## **The Necessary Modification of the Regional Development Methods Regarding to Climate Change Along the Nile River**

**Abstract.** Climate change adds extra stress on the current global situations and the regional development plans. Despite, Africa being rated the least among the continents contributing to the atmospheric pollution, it continues to be responsible for the least global emissions (estimated at 4%). Although they contributed to anthropogenic emission slightly, African continent is one of the highly vulnerable to impacts of long-term climate variability and extreme weather events, especially on the Nile. Moreover, developing countries are the most vulnerable to climate change impacts because they have fewer resources to adapt: socially, technologically and financially. Therefore, this paper is seeking to find and modify the regional development process in the frame of climate change along the Nile river. By considering some examples to accelerate the development process and methods in the Nile's valley regions. Strongly related to the climate change impacts on different sectors and activities such agriculture, industry, energy, and the water supply and demand as well.

**Key words:** climate change, regional development, integrated development, process, water management

**JEL Classification:** O2, Q5, R1

### **Introduction**

Recent climate changes and climate variations are beginning to have effects on many other natural and human systems. Conversely, based on the literature, the impacts have not yet become established trends (Hunt, Watkiss, 2010). Examples include: 1) Settlements in mountain regions are at enhanced risk of glacier lake outburst floods caused by melting glaciers. Governmental institutions in some places have begun to respond by building dams and drainage works; 2) In the Sahelian region of Africa, warmer and drier conditions have led to a reduced length of growing season with detrimental effects on crops; 3) Sea-level rise and human development are together contributing to losses of coastal wetlands and mangroves and increasing damage from coastal flooding in many areas (IPCC, 2007).

Current knowledge about future impacts on freshwater resources and management: Adaptation procedures and risk management practices for the water sector are being developed in some regions that have recognised projected hydrological changes with related uncertainties (IPCC, 2007).

Scenarios: Key impacts as a function of increasing global average temperature change (Impacts will change by extent of adaptation, rate of temperature change, and socio-economic pathway). Descriptive examples of global impacts projected for climate changes (sea level and atmospheric carbon dioxide where relevant) associated with different amounts of increase in global average surface temperature in the 21st century. The black lines link impacts, dotted arrows indicate impacts continuing with increasing temperature. Entries are placed so that the left-hand side of the text indicates the approximate onset of a

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given impact. Quantitative entries for water stress and flooding represent the additional impacts of climate change relative to the Special Report on Emissions Scenarios (SRES) scenarios. Adaptation to climate change is not included in these estimations. Confidence levels for all statements are high (IPCC, 2007).

Table 1. Global mean annual temperature changes relative to 1980-1999 (°C)

WATER	Increased water availability in moist tropics and high latitudes →
	Decreasing water availability and increasing drought in mid-latitudes and semi-arid low latitudes →
	Hundreds of millions of people exposed to increased water stress →
	0 1 2 3 4 5°C
	Global mean annual temperature changes relative to 1980-1999(°C)

Source: Intergovernmental Panel on Climate Change (IPCC): "New Assessment Methods and the Characterization of Future Conditions", Fourth Assessment Report, Chapter draft IPCC, Fourth Assessment Report. Chapter draft, 2007.

### Research methodology

Here's the state of the research methodology, which is qualitative study aiming to improve and modify the regional development process in the frame of climate change along the Nile river. By considering some examples and practical experience to develop the development process, indicators, and methods in the Nile's valley regions. Granting to the climate change impacts on different sectors and activities such agriculture, industry, energy, and the water supply and demand as well. Based on secondary research for international data bases.

### Review of the literature

Climate change is an added stress to already threatened habitats, ecosystems and land uses in Africa and Egypt. Add to that the current global situations concerning the impacts of long-term climate variability and extreme weather events. Although they contributed to anthropogenic emission slightly, Egypt is highly vulnerable to the impacts of long-term climate variability and extreme weather events. Among climate change challenges in Egypt have reduced water available, changing rainfall patterns such threats are undeniable to the future of development in the country. Examples of possible impacts of climate change due to changes in extreme weather and climate events, based on projections to the mid- to late 21st century. These do not consider any changes or developments in adaptive capacity (UNISDR, 2012).

The sharpest disaccord can be seen between the group of Sub-Saharan riparian countries laying in the upper part of Nile and Egypt. The rapidly growing population and her almost exclusive dependence on the Nile-water makes the Egyptian government insist strongly to her quota, which was set in international agreements long ago. The Sub-Saharan countries would amend the prevailing sharing system to another solution which served their interests more, so they considered it more rightful. The international community has been trying to make efforts to settle the issue the best known of them is the Nile-Basin Initiative (1999) which is backed by international organizations like the World Bank, UNDP, etc. (Neszmélyi, 2014).

Table 2. Water resources among the climate change hazards

Phenomenon and direction of trend	Likelihood of future trends based on projections for 21 <sup>st</sup> century using SRES scenarios	Examples of major water resources
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Virtually certain <sup>2</sup>	Effects on water resources relying on snow melt; effects on some
Warm spells/ heat waves. Frequency increases over most land areas	Very likely	Increased water demand; water quality problems, e.g., algal blooms
Heavy precipitation events. Frequency increases over most areas	Very likely	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved
Area affected by drought increases	Likely	More widespread water stress
Intense tropical cyclone activity increases	Likely	Power outages causing disruption of public water supply
Increased incidence of extreme high sea level (excludes tsunamis) <sup>3</sup>	Likely	Decreased freshwater availability due to saltwater intrusion

Source: Intergovernmental Panel on Climate Change (IPCC): "New Assessment Methods and the Characterization of Future Conditions", Fourth Assessment Report, Chapter draft IPCC, Fourth Assessment Report. Chapter draft, 2007.

According to conflict and argument on the issue of distribution and utilization of the water discharge of Nile River among ten African countries namely Burundi, Egypt, Ethiopia, Kenya, Democratic Republic of Congo, Rwanda, Tanzania, Uganda and Sudan. This issue has a considerable influence on the water and food supply of around 300 million people who live in these countries but also a way for electric power generation at a sustainable way. The problem is that needs for water, food and energy are all increasing while the resources are limited. The paper tries to focus on the point that this very complicated issue is not just a zero-sum game for the riparian states but choosing the way of co-operation instead of conflicts may be beneficial for all stakeholders (Toth, Topa, 2014).

Regional Development Policies target all regions (urban, rural and undeveloped areas) and cities in order to support job creation, business competitiveness, economic growth, sustainable development, and improve citizens' quality of life. This can be seen as a general effort to reduce regional disparities by supporting (employment and wealth-generating) economic activities in the regions. Previously, regional development policy tended to try to achieve these objectives by means of large-scale infrastructure development and by attracting inward investment. Awareness of the need for a new approach is driven by the observation that past policies have failed to reduce regional disparities significantly and have not been able to help individual lagging regions to catch up, despite the allocation of significant public funding. The result is under-used economic potential and weakened social cohesion. Also, it is reflected in the country competitive dynamic regions aiming to

<sup>2</sup> Warming of the most extreme days and nights each year.

<sup>3</sup> Extreme high sea level depends on average sea level and on regional weather systems. It is defined as the highest 1% of hourly values of observed sea level at a station for a given reference period.

achieve their economic, social and environmental objectives. Regional development policies complement national macroeconomic and structural policies. In this context, the regional outputs aim at helping countries get regions and cities “right” through the adaptation of policies to the specificities of where people live and work and so improve citizens’ well-being (GustBardon, 2012).

For the economic problems the solutions cannot be purely economic in the case of Sudan and South Sudan. The greatest need is for peace and cooperation, because if not considering the long history of civil wars and disputes, the situation would be quite clear: South Sudan would produce much of the oil, and using Sudan's infrastructure the oil could get transported to the port, and from the profit both countries could develop better infrastructure, invest in new economic opportunities (such as other energy resources, in case of radical change in oil prices) and education, improving social security, urging cooperation with other countries along the Nile, etc. (Toth, Topa, 2014).

The planning process and methods can be classified as follows (György, Tamás, 2012):

**Step 1: To map the requirements of the players in regional development**

- the requirements of inhabitants and visitors,
- the requirements of settlement and municipality associations,
- the requirements of entrepreneurs and their associations,
- the requirements of civil organizations.

Applicable methods:

- Group methods: (interviewing, brain storming, collective notebook (CNB) procedure, logical frame);
- Methods based on macro models: (societal accounting matrix).

**Step 2: The evaluation of environment**

**a, The evaluation of global environment, the drawing up of tendencies:**

- the spatial determination of regional development, its spatial effects,
- the major tendencies of world economy, the possible effects of changes,
- the international development directions of the dominant economic sectors in the area.

Applicable methods:

- Group methods: (regional map of losses, SWOT analysis);
- Methods based on indicators: (indicators based on the comparison of extreme values, deviation-type indicators, public road indicator, complex transportation network indicator (TRANS), pointing methods);
- Mathematical statistical methods: (regression analysis, factor analysis, main component analysis, cluster analysis);
- Optimization methods: (Fuzzy logic);
- Presentation on maps and spatial informatics methods;
- Methods based on models: (regional models, ECO-line model, Socio-line model, LINE model);
- Methods based on macro models:(input-output approach, societal accounting matrix).

**b, The evaluation of national economic environment, drawing up tendencies**

- National economic and sectoral tendencies;
- Public administrative and institution-development tendencies.

Applicable methods:

- Group methods: (logical frame, regional map of losses, SWOT analysis);
- Mathematical statistical methods: (regression analysis, factor analysis, main component analysis, cluster analysis);
- Methods based on macro models: (ECO-line model, Socio-line model, LINE model, input-output approach, societal accounting matrix);
- Presentation on maps and spatial informatics methods.

**c, The evaluation of the instruments and the institutional system of regional development**

- The evaluation of regional development sources;
- The evaluation of the institutional system of regional development;
- The evaluation of efficiency of regional development.

Applicable methods:

- Group methods: (interviewing, SWOT analysis, logical frame, regional map of losses);
- Mathematical statistical methods: (regression analysis, main component analysis, cluster analysis);
- Presentation on maps and spatial informatics methods;
- Methods based on macro models: (LINE model, societal accounting matrix).

**d, The evaluation of development concepts of the area (e.g. the areal directions and results of National Spatial Development Concept)**

Applicable methods:

- Group methods: (interviewing, regional map of losses);
- Methods based on indicators: (indicators based on the comparison of extreme values, deviation-type indicators, public road indicator, complex transportation network indicator (TRANS), Hoover index, pointing methods);
- Presentation on maps and spatial informatics methods;
- Methods based on macro models:(LINE model).

**Step 3: The evaluation of the endowments of the area**

- Societal environment, human resources (societal organizations, cultural features, values, regional identity – demographical structure and forecast, employment conditions, human capacity, institutional network);
- Economic base (major economic sectors and their development directions, the internal and external connections of the economy, the condition of infrastructure, the evaluation of locational factors, the innovation potential of the area, the economic competitiveness);
- Environment (natural endowments, environment, the quality of nature, the influential factors on its formation);
- Infrastructure, the institutional conditions of the area (the population's health, social, educational, cultural, leisure, sport, commercial, service and public administrative institutions, housing);
- The network of settlements, the evaluation of cohesion relationships.

Applicable methods:

- Group methods: (regional map of losses);

- Methods based on indicators: (indicators based on the comparison of extreme values, deviation-type indicators, public road indicator, complex transportation network indicator (TRANS), Hoover index, pointing methods);
- Mathematical statistical methods: (regression analysis, main component analysis, cluster analysis);
- Optimization methods: (Fuzzy logic, Linear programming);
- Presentation on maps and spatial informatics methods;
- Methods based on macro models: (societal accounting matrix).

**Step 4: The dynamic evaluation of the area's conditions and needs**

- SWOT analysis of external environmental conditions;
- SWOT analysis of the area's conditions;
- The reconciliation of the requirements and possibilities of the players of regional development.

Applicable methods:

- Group methods: (SWOT analysis, logical frame);
- Mathematical statistical methods: (regression analysis, factor analysis, main component analysis, cluster analysis);
- Presentation on maps and spatial informatics methods;
- Methods based on macro models: (LINE model, societal accounting matrix).

**Step 5: Setting the strategic aims**

- The main aims and directions of the actual regional development concept;
- The hierarchy of aims, pyramid of aims, connection between the sub-aims, the planned schedule of their implementation.

Applicable methods:

- Group methods: (brain storming, collective notebook (CNB) procedure, Rohr Bach's 635 method, METAPLAN method, logical frame, regional map of losses, SWOT analysis);
- Optimization methods: (Fuzzy logic, Linear programming).

**Step 6: The elaboration of a possible model and scenario of the development**

Applicable methods:

- Group methods: (brain storming, collective notebook (CNB) procedure, Rohr Bach's 635 method, METAPLAN method, logical frame, SWOT analysis);
- Methods based on macro models: (LINE model, societal accounting matrix).

**Step 7: Impact study**

- Proposal for the measuring of the development impacts, possible environmental, economic changes and societal reactions.

Applicable methods:

- Group methods: (SWOT analysis, regional map of losses);
- Mathematical statistical methods: (cluster analysis);
- Presentation on maps and spatial informatics methods;
- Methods based on macro models: (ECO-line model, Socio-line model, LINE model, input-output approach, societal accounting matrix).

**Step 8: Suggestions for a system of instruments and institutions suit the objectives**

- Financial resources;
- Non-financial instruments;
- The organizational frame and human resources of strategic implementation.

Applicable methods:

- Group methods: (collective notebook (CNB) procedure, Rohr Bach's 635 method, METAPLAN method, logical frame);
- Optimization methods: (Fuzzy logic, Linear programming).

**Step 9: Implementation**

- The realization of the strategy, the dividing of programs, projecting.

Applicable methods:

- Group methods: (METAPLAN method, logical frame).

**Step 10: Monitoring**

- The elaboration of the plan to monitor the development process in favour of the realization of objectives;
- Making the necessary corrections because of occurred effects not expected.

Applicable methods:

- Group methods: (interviewing, logical frame);
- Methods based on indicators: (public road indicator, complex transportation network indicator (TRANS), Hoover index);
- Methods based on macro models: (ECO-line model, Socio-line model, LINE model, input-output approach, societal accounting matrix) (Tóth, 2005).



Fig. 1. The countries of the Nile River Basin

Source: [www.pislamonauseacentral.blogspot.com](http://www.pislamonauseacentral.blogspot.com), 2013.

***About the Nile Basin in nutshell***

River Nile is one of the longest rivers of the world, its length is 6,667 km, its catchment area is 3.37 million km<sup>2</sup> (somewhat bigger than the total territory of India). Nowadays Nile has a decisive or at least a very significant role in feeding and supplying 11 countries and their 300 million inhabitants with water. These countries are as follows: Egypt, Sudan (North and South – the latter became independent in July 2011), Ethiopia, the Democratic Republic of Congo, Kenya, Tanzania, Uganda, Rwanda, Burundi and Eritrea. The latter is not riparian country, but the catchment area of the Nile extends to Eritrea as well (Neszmélyi, 2014). The conflict and argument along the issue of distribution and utilization of the water discharge of Nile River has been increasing among ten African riparian countries which are all affected by the climate change hazards, however each of them in different extent and way.

On the basis of forecasts, the population of the river basin of Nile will be doubled between 1995 and 2025. The prevision of the annual flooding periods of the river is cumbersome, the quantity of the surplus-water discharge varies from year to year, and it is also difficult to estimate in advance. From among the eleven countries from the aspect of the Nile the following countries have special importance: Egypt, North and South Sudan, Ethiopia and Uganda (these ones are most concerned by this issue) while in the water supply of the other Sub-Saharan countries the Nile plays a lesser decisive role (DEFRA, 2008).

Table 3. The 7 key challenges formulated in the EU SDS and the associated general objectives

Challenge	Overall objective
Climate Change and clean energy	To limit climate change and its costs and negative effects to society and the environment
Sustainable Transport	To ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment
Sustainable consumption and production	To promote sustainable consumption and production patterns
Conservation and management of natural resources	To improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services
Public Health	To promote good public health on equal conditions and improve protection against health threats
Social inclusion, demography and migration	To create a socially inclusive society by taking into account solidarity between and within generations and to secure and increase the quality of life of citizens as a precondition for lasting individual well-being
Global poverty and sustainable development challenges	To actively promote sustainable development worldwide and ensure that the European Union's internal and external policies are consistent with global sustainable development and its international commitments

Source: Council of the European Union (2006) based on (Watts et al, 2015).

Nowadays for 95% of the population of Egypt (around 95 million people) the water of Nile has vital importance. Inhabitants of Sudan and South Sudan are also strongly dependent on the water discharge of Nile. 86% of the water discharge reaching Aswan, the city in South Egypt derives from Ethiopia (Blue Nile) while 14% (White Nile) comes from Uganda and from other Sub-Saharan countries.

In regional science, the recognition of knowledge as the key factor in regional development started only at the beginning of the nineties. However, human resources appeared already in the seventies as one of the endogenous factors defined by the endogenous development theory. Later, Romer (1990), who is one of the most important representatives of the “new (endogenous) growth theory”, highlighted in his growth theory the importance of creation of knowledge. The argument of Romer was that knowledge is a determining form of capital and economic growth depends primarily on the level of the accumulation of knowledge. One of the most important attributes of knowledge-based economies is that creation and employment of knowledge constitute the essence of the value creation process (Hunt, Watkiss, 2010).

The clarification (Watts et. al, 2015): „Keeping in view the ever-worsening environmental trends, the EU’s social and economic challenges, the pressure of competitiveness weighing on it and new international responsibilities, the EU SDS identifies 7 key challenges and corresponding targets, operational objectives and actions” (Table 3).

## **Discussion and Findings**

According to the situations and hazards, and the efforts to plan and achieve the regional development in such regions which are threatened by climate change hazards or other environmental issues, here’s some suggestions for improving the regional development process to stay beside achieving the sustainable development goals objecting better and quality of life, as follows:

### **Step 1: To map the requirements of the players in regional development**

- *the requirements of ecological context, and CO2 emissions for the different uses and activity.*

#### Applicable methods:

- *Group methods: (specialise ecological maps and studies).*

### **Step 2: The evolution of environment**

#### **a, The evaluation of global environment, the drawing up of tendencies**

- *Determine the ecological and environmental hazards as a main side of the spatial regional development.*

#### Applicable methods:

- *Group methods: (regional map of losses, SWOT analysis.)*

#### **b, The evaluation of national economic environment, drawing up tendencies**

- *Environmental economic losses, for the different uses and activities.*

#### Applicable methods:

- *The relation between the ecological footprint and the Human Development Index, as an indication and illustration the balance between the ecological losses and their impact on the development.*

#### **c, The evaluation of the instruments and the institutional system of regional development**

- *The evaluation of regional development resources and vulnerability.*

#### Applicable methods:

- *Risk Assessment, and Territorial Impact Assessment (TIA) models.*

**d, The evaluation of development concepts of the area (e.g. the areal directions and results of National Spatial Development Concept)**

**Step 3: The evaluation of the endowments of the area**

**Step 4: The dynamic evaluation of the area's conditions and needs**

**Step 5: Setting the strategical aims**

**Step 6: The elaboration of a possible model and scenario of the development**

**Step 7: Impact study**

- *Proposal for the measuring of the development impacts, possible environmental, economic changes and societal reactions.*

Applicable methods:

- *Methods based on macro models:(ECO-line model).*

**Step 8: Suggestions for a system of instruments and institutions suit the objectives**

**Step 9: Implementation**

**Step 10: Monitoring**

## **Conclusion and Recommendations**

The research suggests several recommendations, mainly modifying the development process to fit all the environmental needs and to tackle the hazards by applying adaptation policies regarding to most of the previous studies, which has no doubt in the results of climate models that have been used to predict future changes in water resources in the event of expected climate change. Therefore, the study recommended the development of adaptation strategies and proposed institutional arrangements for water (The Nile), under a joint coordination and the selection of suitable alternatives for all, which are useful in all aspects (especially in case of climate change) (which is called "regret no"), previous studies indicated Egypt can adapt to a 10% to 15% in inflows while a decrease of 20% or more will have a significant social and economic impact. In the event of a decrease in flow it is recommended to find an appropriate balance between the high flood risks and the severe drought risks when developing rules for the operation of the High Dam and Integrated Management of Lake Nasser.

The region passes through several stages of development, the advanced and developed region is the sphere which supports sustainability, ecological and environment sectors these achieve by:

- Modifying the development process to fit all the environmental needs.
- Enhancing the regional development policies strongly related to the climate change and the environment aspects
- Identifying climate change scenarios (such as studying modern science - Continuing educational missions for technologically advanced countries).

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