Miriam NDINI[*], Liri MUÇAJ[*], Eglantina BRUCI[**]

IMPACTS OF CLIMATE CHANGES ON WATER RESOURCES

Përmbledhje: Resurset ujore janë shumë të ndjeshme ndaj elementëve të klimës dhe ndryshimeve të saj. Skenarët e klimës, të zhvilluara për Shqipërinë, projektojnë një rritje të temperaturave dhe zvogëlim të reshjeve. Për pellgun e Drinit, rezultatet e këtyre skenarëve për një afat të gjatë, projektojnë një zvogëlim të rrjedhës mesatare vjetore dhe asaj sezonale. Këto ndryshime do të ndikojnë edhe në resurset ujore disponibël si dhe në frekuencën e ngjarjeve ekstreme si plotat dhe thatësirat. Për sa i përket skenarëve për ndikimin e pritshëm të nivelit të detit, projektojnë një rritje të humbjeve të zonave ligatinore, dhe si pasojë e kësaj, pritet një zvogëlim i këtyre zonave në total. Edhe zonat bregdetare, subjekte të përmbytjeve si dhe popullsia që jeton në këto zona, do të ndikohen veçanërisht nga ndryshimet e pritshme klimatike.

Fjalët kyçe: *ndryshime të klimës, reshje, temperatura, rrjedhë, skenar*

Abstract: Freshwater resources are highly sensitive to weather and climate changes. The climate scenarios developed for Albania show a likely increase in temperature and decrease in precipitation. The scenario leads to a decrease in the long term mean annual and seasonal runoff for the Drini water basin. These changes will affect patterns of freshwater availability and will alter the frequencies of floods and droughts. The scenarios of the expected impacts of sea level rise project an increase in losses of wetland area, and as a consequence a decrease in total wetland area. It projects as well increases in coastal floodplain area and population.

Key words: *climate change, rainfall, temperature, runoff, scenarios.*

INTRODUCTION

Human existence is linked to water. Without drinking we can live only few days, our ecosystems and biodiversity depend on water, we need water to grow our food, we need water to sustain almost all our productive activities, and we need water to carry away our wastes. Water is everywhere around us: the rain and snow hits the land, where it either runs off and appears as rivers or lakes, or seeps into the ground

[*] Miriam Ndini, Liri Muçaj, Institute for Energy, Water and Environment, UPT

[**] Eglantina Bruci, UNDP Climate Change Programme

to sustain vegetation and replenish our vitally important bank of groundwater. *Water is to our environment like the blood of the body*: it nurtures all parts of it, and all parts depend on it to function properly[1].

The global climate has been changing and the inhabitants of the Earth have had to either adapt to these changes, or disappear. Some changes have been slowly evolving over millenniums; others have been faster, evolving over centuries, or even decades. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC, 2007). The world's average surface temperature has increased by around 0.74°C over the past 100 years (1906–2005). A warming of about 0.2°C is projected for each of the next two decades (IPCC, 2007).

Climate change scenarios for Albania

The likely changes in temperature and precipitation for Albania are presented in Table 1. Referring to the scenarios an increase in temperature and decrease in precipitation is expected. So, we may expect: milder winter, warmer springs, hotter and drier summer and drier autumn. Figure 1 depicts likely annual changes for the northern part of Albania.

The annual increase in temperature accounts for 1.0, 2.0 and 4.1°C respectively by 2025, 2050 and 2100. For the 2025, an average increase of 0.8°C is expected for winter and spring, of about 0.9°C and 1.3°C for autumn and summer. A similar trend is expected for the 2050 and 2100. An average increase in annual temperature up to 2.0°C and 4.0°C is expected respectively. A high warming during summer,

Table 1. Climate change scenarios for Albania

Scenarios	for Albania	Time	horizon	
		2025	2050	2100
Annual	Temperature °C	0.8 to 1.1	1.7 to 2.3	2.9 to 5.3
	Precipitation %	- 3.4 to -2.6	- 6.9 to -5.3	- 16.2 to -8.8
Winter	Temperature °C	0.7 to 0.9	1.5 to 1.9	2.4 to 4.5
	Precipitation %	- 1.8 to -1.3	- 3.6 to -2.8	- 8.4 to -4.6
Spring	Temperature °C	0.7 to 0.9	1.4 to 1.8	2.3 to 4.2
	Precipitation %	- 1.2 to -0.9	- 2.5 to -1.9	- 5.8 to -3.2
Summer	Temperature °C	1.2 to 1.5	2.4 to 3.1	4.0 to 7.3
	Precipitation %	- 11.5 to -8.7	- 23.2 to -17.8	- 54.1 to -29.5
Autumn	Temperature °C	0.8 to 1.1	1.7 to 2.2	2.9 to 5.2
	Precipitation %	- 3.0 to -2.3	- 6.1 to -4.7	- 14.2 to -7.7

[1] Torkil Jønch Clausen, Carsten Bjerg, The Blue Revolution: Adapting To Climate Change. Thought Leadership Series #6

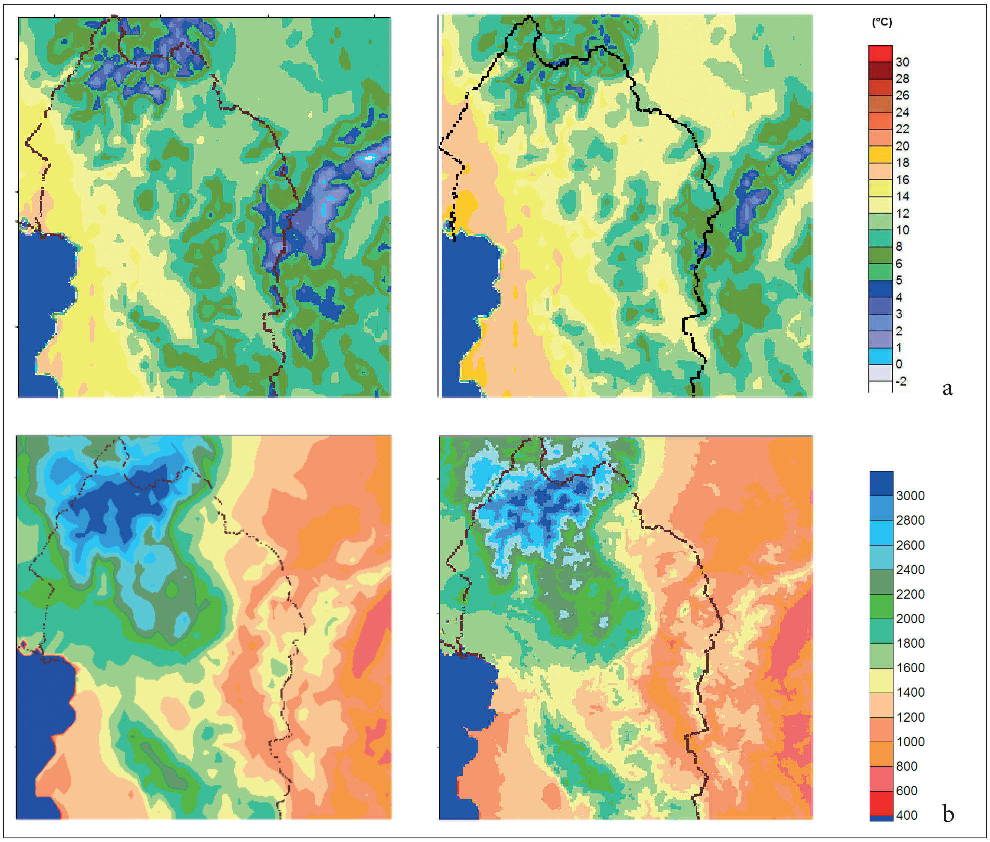

Figure 1. Expected changes in temperature (a) and precipitation (b).

up to 2.8°C (2050) and 5.6°C (2100) might be expected (Fig. 1, Table 1). It is likely to expect a higher increasing rate in the minimum than the maximum temperatures.

Concerning precipitation, the annual scenario leads to a decrease of annual value up to 3.0%, 6.1% and 12.4% for the 2025, 2050 and 2100 time horizons. A drastic decrease in precipitation total is likely in summer. This decrease is likely to reach up to 9.9%, 20.5% and 41.3% respectively. July is likely to have highest contribution in this decrease (-19.6, -23.5 and -49.7% respectively by the 2025, 2050 and 2100).

Likely changes in other climatic parameters

A dry summer period was predicted for Shkodra area. This is ascribed to a combination of the increased temperature (likely increase up to 5.6°C) and potential evaporation that is not balanced by the precipitation (reduction around 41%).

Recent investigations show that increasing temperatures will be followed by increase of probabilities of extreme events and a higher intra-annual variability of minimum temperatures. Increases more in daily minimum than maximum temperatures are likely to occur over the study area. More frequent and severe droughts with greater fire risk are likely.

Decrease in number of frozen days (temperatures ≤-5°C) in high altitudes is likely to occur. It accounts for about 4–5 days, 9 days and 15 days respectively by 2025, 2050 and 2100.

It is to be pointed out that with higher average temperatures in winter expected, more precipitation is likely to fall in the form of rain rather than snow, which will increase both soil moisture and run-off. It is to be mentioned that increase in total precipitation rate may induce greater risks of soil erosion, depending on the intensity of rain episodes.

The extreme high increase in summer temperature is likely to result in increases to the frequency or intensity of extreme weather events (heat waves).

The analysis shows that the number of days with the temperature ≥35°C is likely to increase about: 1–2 days by 2025 and 3–4 days by 2050 related to 1951–2000. There is expected also an increased value for this indicator by 2100 (about 5–6 days over the mountainous part, and up to 8 days on the low land)

The expected changes in surface air temperature and humidity are projected to result in increases in the heat index (which is a measure of the combined effects of temperature and moisture). More hot days and heat waves are very likely over nearly all study area. These increases are projected to be largest mainly in the low part of study area where soil moisture decreases are likely.

Although precipitation total is expected to decrease, an increase of intensive rain episodes is likely. So, we can expect an increase in the number of hazardous rainy days of about 1–2 days by 2025 related to 1951–2000, of about 2–3 days by 2050, and of about 3–5 days by 2100.

Expected impacts in water resources

The patterns of change are broadly similar to the change in annual precipitation-increases in high latitudes but decreases in mid-latitudes. But the general increase in evaporation means that a reduction in runoff will be probable (EEA 2005, EEA 2007).

The Drini River watershed is characterized by precipitation during winter falling as snow in the east and northern part and as rain in the western part of it. For the catchments of the most branches, as Valbona, Shala etc, a major proportion of annual stream-flow is formed by snow melting in spring. A rise in temperature would mean that more precipitation falls as rain and therefore that winter runoff increases and spring snowmelt decreases.

The most important climate change effect in this basin is a change in the timing of stream-flow through the year. Increased temperatures means a smaller proportion of precipitation during winter falls as snow, so there is proportionately more runoff in winter and, as there is less snow to melt, less runoff during spring. Increased temperatures, in effect, lead to an increase of evapotranspiration reducing the size of the reservoirs storing water during winter.

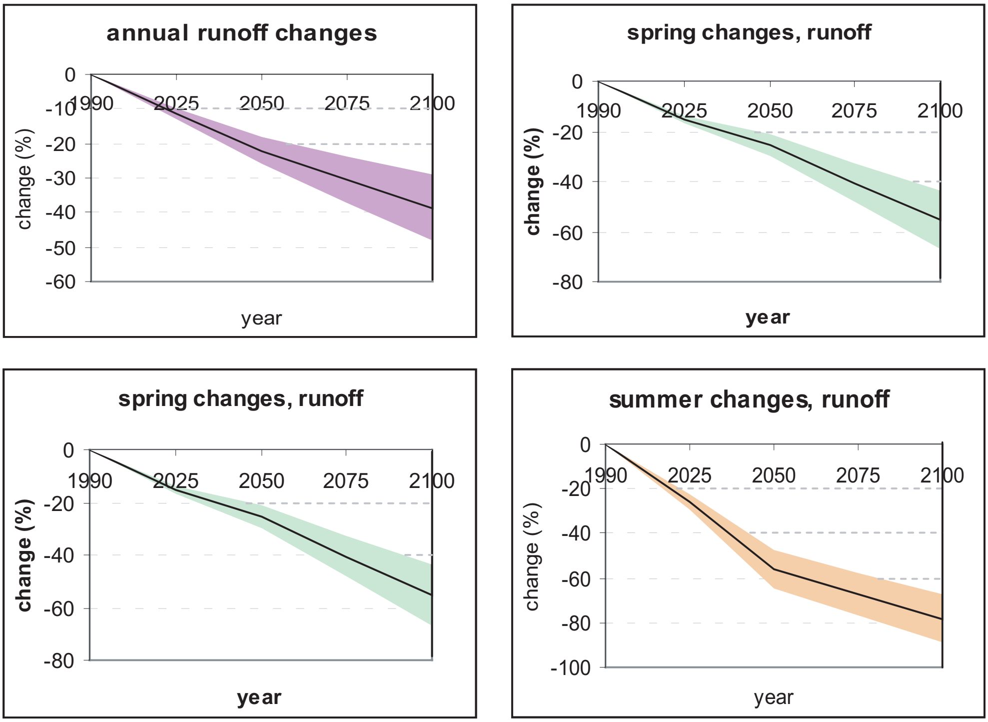

Figure 2. Expected runoff changes

The likely impacts of climate changes in water sector are ordered as follows:

– An increase of the long term mean annual and seasonal air temperature and a decrease of mean annual and seasonal precipitation (combined with higher evaporative demand) would result in a decrease in the long term mean annual and seasonal runoff for the Drini water basin (Fig. 2);

– There are no significant changes for the winter for all time horizons, up to maximum 7% by 2100. The floods will still occurred during this season and the flood of spring time will shift toward the winter;

– Higher temperatures will shift the snowline upwards; the seasonal patterns of snowfall are likely to change with the snow season beginning later and ending earlier. So, the spring runoff is expected to reduce noticeably. The maximum reduction accounts for 30% and 66% respectively by 2050 and 2100. It must be taken into consideration by the Hydropower industry;

– River flood risk generally would increase, the time of greatest risk would move from spring to winter. Effects on groundwater recharge (a major resource of this catchment) could be increased by climate change;

– Sea-level rise can cause several direct impacts, including inundation and displacement of wetlands and lowlands, coastal erosion, increased storm flooding and damage, increased salinity in estuaries and coastal aquifers, and rising coastal water tables;

– The ground water supply will be affected by decreased percolation of water due to decrease in the amount of precipitation and stream flow, and losses of soil moisture from increased evapotranspiration;

– Reduction in ground water supply in combination with increased salinity of the ground water supply will bring a shortage of drinking water in adequate quality.

The scenarios of the expected impacts of sea-level rise project an increase in losses of wetland area, and as a consequence a decrease in total wetland area. It projects as well increases in coastal floodplain area and population. Coastal forest area and low un-vegetated wetlands area are likely to decrease (WCASP–67 2004).

An increase in annual temperature of about 4.1°C for 2100 may cause the reduction of the dissolved oxygen content in water bodies consequently the degradation of aquatic habitats.

Climate change is expected to lead to increased river and lake temperatures, due to the increased air temperature. Changes in water temperature affect water quality. For example, the saturation concentration of dissolved oxygen and the reaction rates of BOD, nitrogen and phosphorus with dissolved oxygen and with phytoplankton, will all change in response to water temperatures changes. This effect will be more dangerous during summer when temperature will increase up to 5.6°C for 2100 (Hennessy, 2003).

To-date studies on impact assessment

The climate impact on water resources cannot be treated separately from the impact of water on other systems (natural and managed ecosystems) and social-economic sectors. Within the frame of the National Communications of Albania (FNC, 2002), an integrated assessment of impacts of climate change, including variability, is performed. Based on this assessment, the Protected Areas of Kune-Vain and Patok that harbor globally significant biodiversity have been identified as critically vulnerable areas of the country. Given the importance of the ecosystem, a project entitled „Identification and implementation of adaptation response measures in Drini-Mati River deltas (DMRD)", funded by GEF, Government of Albania and UNDP, has started.

The focus is on increasing the capacity of the DMRD ecological system to be resilient to climate change, by first identifying, and then integrating climate change response measures into conservation and development programming in the DMRD and piloting some critical adaptation. The specific objective of the project is to build adaptive capacities in the DMRD in order to help vulnerable ecosystems and local livelihoods to adapt to climate change. This will be achieved by addressing the information, awareness, and technical capacity barriers that are inhibiting the government at the regional and central level, communities and NGOs from identifying and implementing specific adaptation response measures in the DMRD.

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