

# IMPACTS OF CLIMATE RESULTS IN ALBANIAN AGRICULTURE SHKODRA REGION

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**Abstract**—A lot of observations has shown that precipitations and temperatures are becoming unstable in each season, which have made agriculture more vulnerable to such changes. Scientists have highlighted that there is a need to consider more seriously climate change impacts in agriculture policies and decision-making. As being an emergent problem we aim to bring in consideration the regional impacts of climate change in agriculture in Albania. This paper, is part of our Ph.D. research and introduces a problematic situation related to climate impacts on crops yields. Our case study is focused in Shkodra region which is located northwest of Albania and it is considered as one of the most vulnerable area. The area is characterized by abundant precipitation in winter which goes up to (1884.4 mm/year) whereas the annual mean temperature for the entire zone remains about 15°C. According to Second National Communication of Albania to UNFCCC. (2009) it is expected that climate is going to bring more stress for agriculture crops. Agriculture is an important sector for Shkodra whereas the land is mostly flat and fertile and has around 14.05% of total agricultural land in Albania. Results revealed that seasonal temperatures and precipitation respond differently in crops where higher precipitation in winter has caused a reduction in wheat yield whereas higher levels of temperature in spring has a positive impact in wheat yield.

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**Index Terms**—climate change, agriculture, extreme events

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## I. INTRODUCTION

Agriculture is as an important sector which contributes around 20% of Gross Domestic Product ‘GDP’ (2011) in Albania, but it is characterized by smallholding farms with poor infrastructure, land fragmentation that hinders the effective organization of production, low level of mechanization, lack of productivity and high cost of production. According to Second, and Third National communication of Albania to UNFCCC (2009, 2016) the responses of agriculture systems to climate change are driven by changes in crop yields as this strongly influences farmer decisions and their profitability in the country. A study done from World Bank (2009) states that Albanian agriculture is already being highlighted by the consequences of climate change with increasing exposure to high temperatures, droughts, shifting seasonal patterns, increased pests and diseases, and increase soil erosion. They concluded that agriculture is influenced by climate change, particularly changes in the last 10 years. The expected increase of temperatures in summer will bring negative effects for the majority of agricultural crops. Based (FAO 2008), (IPCC 2001), it is implied that climate change will affect food security on all components of global, national and local food systems. What is more, Stage (2010), explained that for countries where subsistence production is important, the impacts of climate change on food production have to be modeled explicitly in order to give some idea of what will be the overall impacts on livelihoods.

A few studies are done in Albania in analyzing climate change impacts in agriculture, beside, lack of historical data, the absence of balance sheet from smallholders in their farm activities, have made such

studies difficult in determining the exact impacts of climate change in food production. Based on previous studies, shows that Albania, is facing a high level of exposure to risks arising from the results of climate change but other factors like geographical-physical conditions, low adaptive capacities and technologies are other important factors to keep in consideration. There are many important things to consider when taking Shkodra region as our case study.

Firstly, Shkodra is one of the regions most vulnerable to climate change as the extent of its geographic position, hydropower plants that are build in the region, and for its economic and social aspects. Moreover, agriculture is the main source of incomes for smallholders in the region. Agriculture production in Shkodra also occupies an important place in the GDP.

Based on the scenarios used in the Second National Communication to UNFCCC (2009) it is predicted that temperatures will increase during this century and the actual temperatures are exceeding projections scenarios. Precipitation levels also tend to decline, whereas increasing the incidence of extreme events.

## II. METHODS

Unfortunately, we couldn't find historical data for many crops and we also faced lack in collecting historical economic data and soil type of the region, which limited the use of appropriate model in defining the impacts of climate change in crops. Our analysis where based only on climate data and wheat yield. Methods used includes statistical analysis by using cluster techniques, tabular, graphical presentation and regression analysis as well. The quantitative historical

data for climate and crops were obtained from Institute of Geosciences, Energy, Water and Environment and from Ministry of Agriculture. The data for climate includes seasonal average temperature and precipitation from 1961 to 2010, and annual yield for wheat from 1961 to 2010. We intended to see if there were any relationship among these variables and which seasonal climate have had impacts in wheat yield for fifty years. SPSS was the program used for analyzing our data.

### III. CLIMATE AND AGRICULTURE CHARACTERISTICS OF SHKODRA REGION

Shkodra region is located in north-west of Albania and it is extended in four geographic landscape (hilly, field, coastal and mountains). This position has disposed diversities regarding to plants cultivation and climate conditions. Normally, there are different requirements for water and temperature in the region though not all villages have the same problem regarding to temperature and precipitation. Based on farmer's observations Shkodra is facing disorder in temperatures and precipitation regimes, whereas extreme events like hit waves and floods are occurring more often.

Most of smallholders have increased the use of pesticides and chemicals in order to cop with plants

diseases. Below we can see some temperatures anomalies in this region for a long period of time.

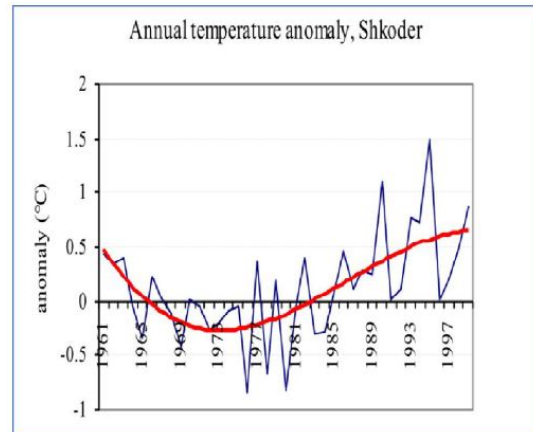


Figure 1 Annual temperature anomalies in the Shkodra region. Source: Second National Communication of Albania to UNFCCC. (2009)

Heavy rain falls characterize autumn and winter season in Shkodra. Throughout decades this region has experienced many floods in which we can mention floods in 1963, 1970-1971, 1977, 1983, 1992 and floods occurred in 2010 which are shown in the figure below.



Fig2. Drini river delta, Shkodra. December 2010. Source: MAP from German Aerospace Centre

[https://www.zki.dlr.de/system/files/media/filefield/map/low/DLR\\_20101206\\_Albania\\_flood\\_disaster-extent\\_detail\\_low.jpg](https://www.zki.dlr.de/system/files/media/filefield/map/low/DLR_20101206_Albania_flood_disaster-extent_detail_low.jpg)

Floods in 2010 were primarily a result of heavy rainfall and continuous high temperatures unusual for the winter month from 15°C to 17°C, which melted the snow in the mountain and increased the water flow. This resulted in the creation of a critical situation in the Drini hydropower plants and water reservoirs as well as downstream. Therefore, engineers had to open the doors of Dam in order to prevent bigger catastrophes. These outcomes flooded around 14,000 ha arable land and caused a lot of damage in agriculture crops and livestock. In general climate is not the only factor that determine agriculture productivity, quality of seeds, soil type, technology are other factors as well.

During communism regime which ended in the end of eighties, agriculture production was increased according governmental policies and all land were public. At that time agriculture was very important sector for the GDP of Albania and for employment. Today most of farms existas private farming system but they arefacing many challenges regarding to cost of production and management. Climate change results would make their farm activates unstable. In the figure below we have shown fluctuation of wheat yield throughout decades.

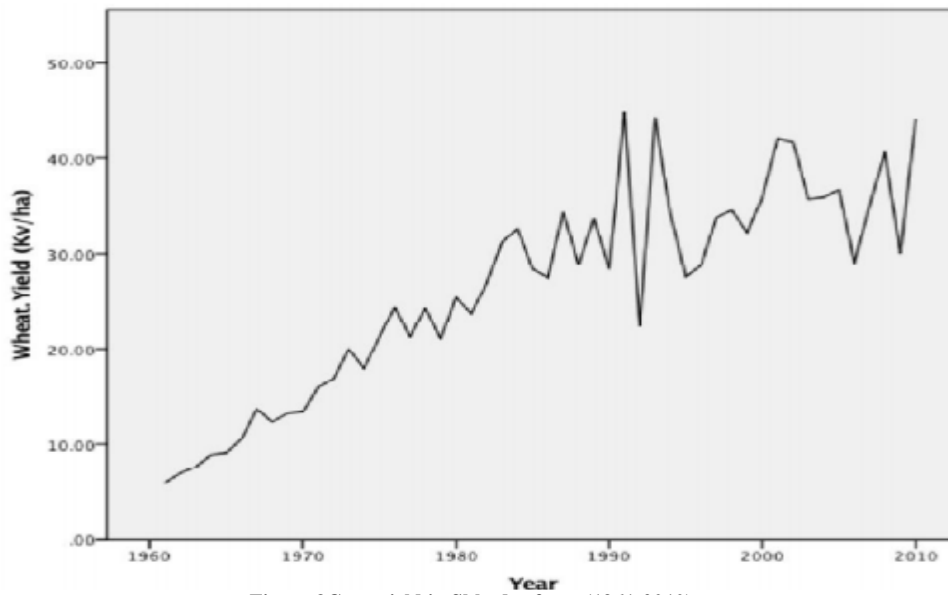


Figure 3Crop yield in Shkodra from (1961-2010)

Needless to say, extreme events have been determinant in annual crops yield for the country throughout decade. From the figure above it is obvious

shown the reduction of wheat yield in the period when flood occurred. Fig.4 shows the mean annual precipitation from 1961 to 2010.

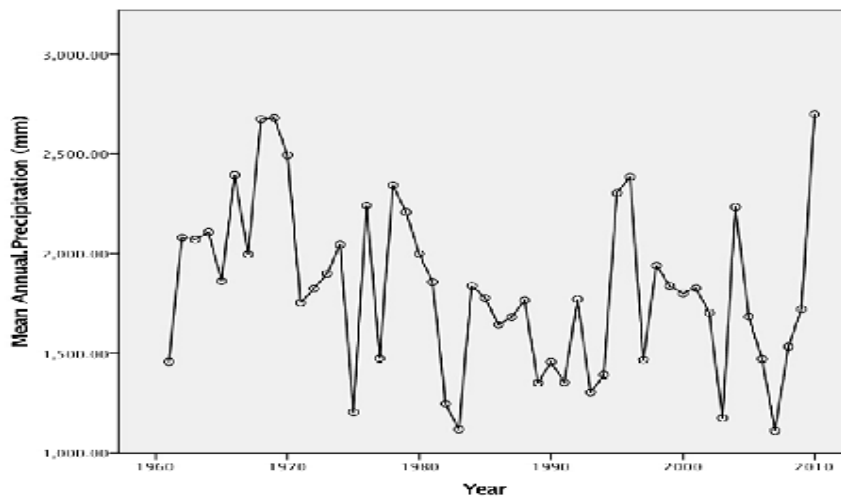


Figure 4. Mean annual precipitation (mm)

In order to see if there were any seasonal impacts or relationship of changes in temperatures and

precipitation in wheat yield we selected data for both climate variables and crops for fifty years.

#### IV. FINDINGS

From the analysis, resulted that wheat yield have had in general an increase trend from 1961 to 2010. In the table below are shown the results.

**Dependent variable: wheat. yield (kv/ha)**

Equation	Model Summary		Parameter Estimates				
	R Square	F	df1	df2	Sig.	Constant	b1
Growth	.762	153.489	1	48	.000	2.367	.031

The equation from the table is as following:

$$Y = 2.367x^{.031}$$

It expresses a considerable annual increase of wheat yield by 3.1%. whereas the model is significant (R2= 0.76)(F= 153.5)(sig at 1%)

According to stepwise method in regression analysis not all seasonal climate variables where important in the model. Below we have shown some results of the important variables.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.351 <sup>a</sup>	.123	.105	10.16869
2	.445 <sup>b</sup>	.198	.164	9.82657

a. Predictors: (Constant), Av.Temp.Spring

b. Predictors:(Constant), Av.Temp.Spring,Av.Prec.Winter

Where:

Av.Prec.Winter.(mm) express average precipitation in winter whereas Av.Temp.Spring.(°C) express average temperature in spring.

**Dependent variable: wheat. yield**

Model		Coefficients <sup>a</sup>				t	Sig.
		Unstandardized Coefficients		Standardized Coefficients			
		B	Std. Error	Beta			
1	(Constant)	-27.511	20.775			-1.324	.192
	Av.Temp.Spring	3.748	1.443	.351		2.597	.012
2	(Constant)	-13.689	21.129			-.648	.520
	Av.Temp.Spring	3.302	1.411	.309		2.340	.024
	Av.Prec.Winter	-.012	.006	-.277		-2.098	.041

$$Y = -13.68 + 3.3x_1 - 0.012x_2$$

Where:

Y= wheat yield (kv/ha), x1= average temperature in spring(°C)x2= average precipitation in winter (mm).

From this results we can say that average precipitation in winter and average precipitation in spring were seasonal climate factors that have had impacts in wheat yield in fifty years, whereas the other seasonal climate variables were not important in the model. Negative single for x1(average precipitation in winter) imply a negative impact on wheat yield, whereas an

expected increase of temperature in summer by assuming other factors constant would increase yields for wheat. Moreover, December was the month in which precipitation have had negative impacts in wheat yield.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.354 <sup>a</sup>	.126	.107	10.15445

a. Predictors: (Constant), Dec.Prec

Model		Coefficients <sup>a</sup>				t	Sig.
		Unstandardized Coefficients		Standardized Coefficients			
		B	Std. Error	Beta			
1	(Constant)	33.655	3.144			10.703	.000
	Dec.Prec	-.031	.012	-.354		-2.626	.012

Dependent Variable: Wheat. yield

$$Y = 33.65 - 0.031x$$

Where:

x represents average precipitation in December. From the equation, we can say that if there is an expected increase of average precipitation in December by 1%, then it will decrease wheat yield by 3%.

To conclude with, seasonal changes of precipitation and temperature have affected wheat yield in Shkodra both positively and negatively. From the graphical description the periods when floods occurred it correspond with reduction of wheat yield, though lead us to say that extreme events were determinant in the stability of wheat yield.

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