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Investigation of droughts and fertility relationships

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Summary: Drought is one of the most dangerous atmospheric events for agriculture. Every year, damage to the farm as a result of drought in different regions of the world is estimated at $ 1 million. However, in some cases, the damage to the farm is due to other reasons, but it is also related to the droughts. In this article, the matter a bit clarified by using the concept of angle coefficient of the trend. Thus, the angle ratios of the trend and productivity are calculated for a particular given period, and the compatibility between angle ratios for both rows is investigated. If the change between lines is seen, then it is accepted that, drought is the reason of productivity change. Otherwise, the effects of other factors are investigated.

Keywords: trend, anglecoefficient, drought, productivity, period, line.

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I. INTRODUCTION

Drought has a special place in the research carried out to implement the world food program. This is due to the fact that the phenomenon of nature is closely related to the economy and it is a more dangerous process. Information about how drought damaged economy of different regions of the world can be found in a wide range of studies [3]. However, researches in the area ofdrought and productivity relationships, I think, are far less than modern ones. The reason for this is probably the lack of assessment criteria. Thus, productivity depends on both the drought and the effects of other climatic anomalies (strong lubricants, hail, flames, strong winds, floods, pests, diseases). Therefore, it is very difficult to evaluate the effects of drought on a large number of factors.

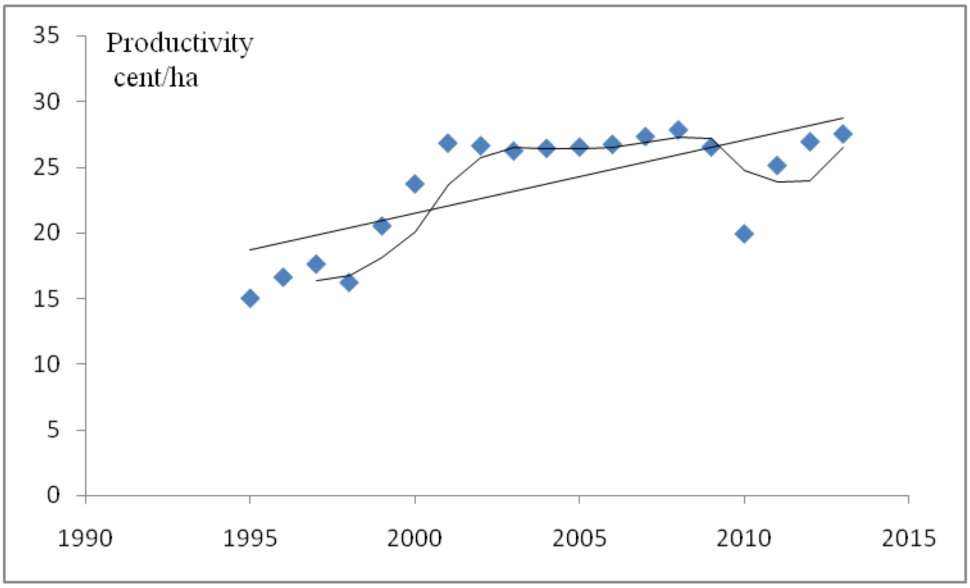

Figure 1. Productivity of autumn wheat in the Republic in 1995 -2014, cent/ha

Figure 1 shows the productivity of autumn wheat in the Republic between 1995-2013. From the graphic, the productivity of wheat till 2001 (2008, 2013) has increased to 27.8 and 27.5 c / ha, some stability till 2008, and a decrease since 2009 is observed. The highest decrease was observed in 2010, when the productivity in the same year decreased from 26.5m / ha to 19.9 c / ha. This means a decrease of about 25% of productivity.

Data from the State Statistical Committee of the Republic of Azerbaijan and the Hydrometeorology Department were used to investigate droughts and productivity relationships taking into account various relief features of Azerbaijan.

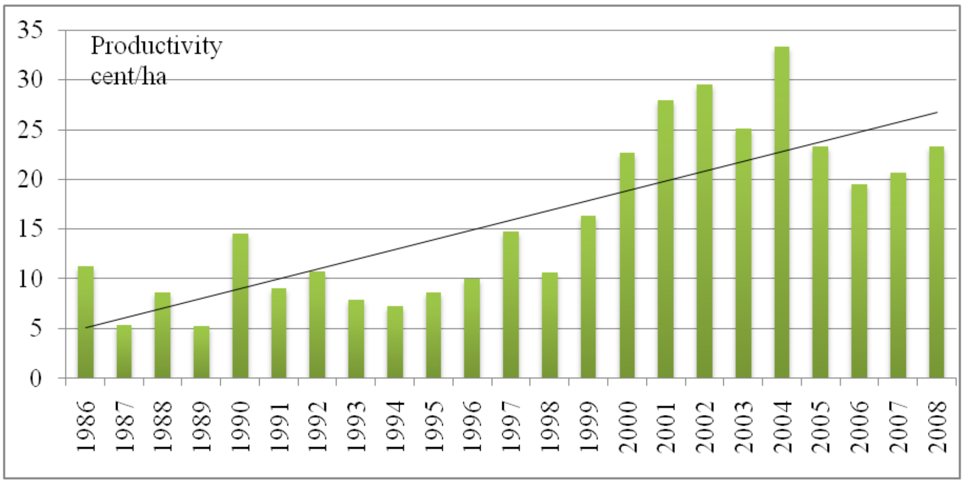

Figure 2. Productivity of autumn wheat inAzerbaijan in 1986- 2008 (c/ha).

The productivity of summer wheat in Azerbaijan increased about 30 cents per hectare from 1986 to 2005, it decreased a bit in(10 cents / ha) in 2005 - 2008. In the period between 1987 and 1997, the increase in productivity was 3-4 cent / ha, whereas in 1999-2004 this increase reached to around 14-15 cents / ha, but in the following years, it decreased about 5-6 cents / ha (Figure 2). In 1999, during the period covered by 1999-2008, productivity has not changed on average. It is also possible to analyze the drought on the trend condition. Figure 3 shows the number of dry seasons for different regions of Azerbaijan. As can be seen from the figure, the direction of trend reflecting drought in the period of 1986-2008 is the same as the trends for the productivity trend. Here, the number of dry seasons has increased slightly. This increase is more noticeable in the years of 1986-1998. In 1999-2008, there was a decrease in the number of dry seasons [2,3].

The angle coefficient of the trend in the evaluation of drought-productivity relationships

For the first time, it is proposed to use the concept of the angle coefficient of the trend to investigate drought-productivity relationships. By the angle coefficient of the trend, we mean the value between the angle and the time-axis. Thus, the decrease of this value for drought means the increase of productivity.

It is known that, the increase or decrease of productivity may not be related to drought. The clarification of the issue is only possible due to the angle coefficient of the trend. Meanwhile, if the angle coefficient of the drought trend corresponds to the angle coefficient of theproductivity, then decline in productivity will be due to drought. Otherwise, the factors influencing productivity are of other reasons. If we point drought angle as k_q, then for estimating productivity $0< k_q/k_m <1$ condition must be accepted. At this time, bydecrease of k_q/k_m,the productivity increases.Thus, the higher k_q/k_mratio, the higher the influence of drought on productivity. Thus, the higher the value of the angle coefficient,the higher the drought's influence on the productivity of the agricultural industry.

The angle of the trend for spring sowing was $k_m= 30^0$in Figure 2,but in Figure 3 it is $k_q=8^0$for drought.

As it was noted, the reasons of productivity decrease are different, there is no one general way for choosing drought among these many branchy effects. Of course, the matter can be positively solved by analyzing objective and subjective factors in the definite region. But it is practically impossible to get information about all these factors. In most cases, while investigating drought and productivity relationship the direction of the trend is the same with productivity relationship, in this case there is result. Besides, the drought happening during autumn and winter is dangerous for autumn wheat, but it is not dangerous for spring wheat. Or, the drought happening in spring is dangerous for spring wheat. But in all cases, the results of these can be seen in total value of the productive capacity. Here, the accepted angle coefficient criterion gives opportunity to have results not only quality, but also quantity results.

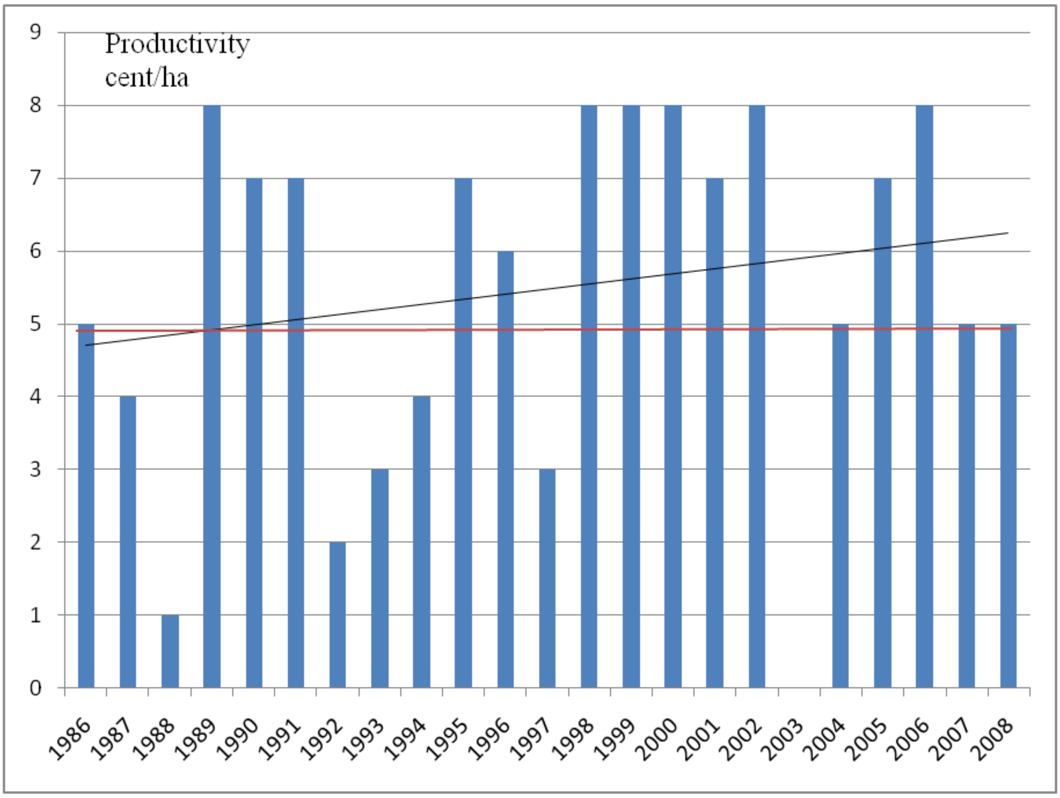

Figure3. The defined droughts in 1986-2008 in 10 districts of Azerbaijan.

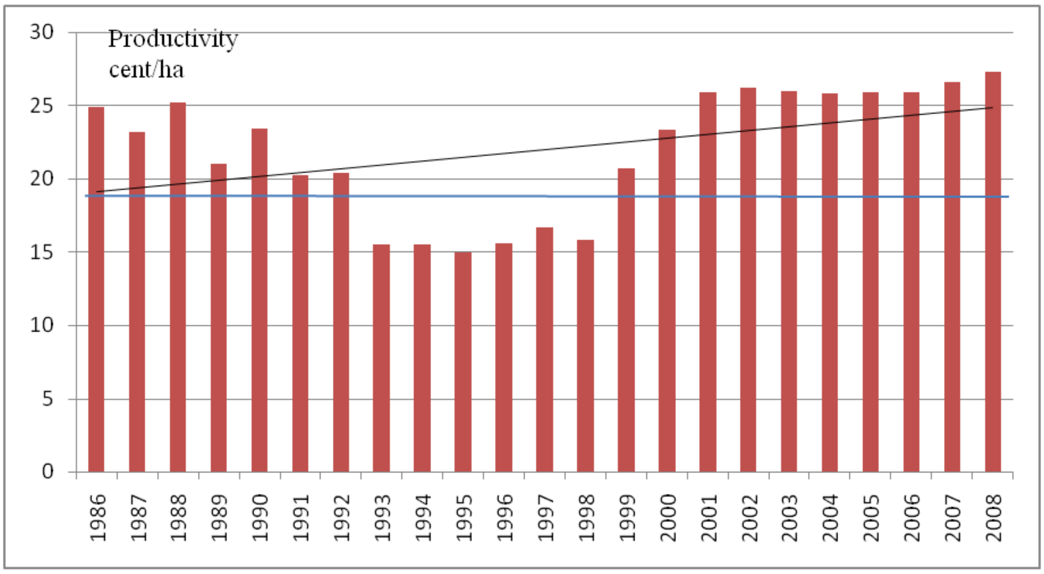

Figure4. The total productivity of grain in 1986-2008 in Azerbaijan (cent/ha).

While investigating drought and productivity relation it must be taken into account drought degre in the regions. Thus, drought with different degrees in different seasons influence differently on productivity. Now, let's look at the above-mentioned relation forms according to the data obtained from different regions.

Table 1.Drought and productivity relation in different regions of Azerbaijan

Regions	Number of drought periods			Productivity sent/ha		
	2000	2005	2008	2000	2005	2008
Absheron	2	1	1	10.6	14.3	14.2
Ganja	3	1	2	14.5	24.2	16.6
Dashkasan	2	1	1	6.1	10.5	20.2
Zagatala	2	2	2	27.4	32.8	37.5
Lankaran	3	1	1	22.8 22.8	21.0	19.7
Guba	3	3	2	19.0	23.7	22.9
Jafarkhan	2	2	-	0.9	42.0	38.3
Shamakhı	3	2	1	0.0	23.5	20.6
Nakhchivan	1	-	1	5.6	38.7	21.5

As it is seen from Table 1, by increasing drought periods the productivity decreased in regions. But in some regions this pattern was violated,this is because of other factors, as we mentioned before. For example, the carried out research shows that, though 3 seasons were drought in Shamakhy in 2000, productivity did not differ a lot as it was in 2008 (1 season was drought). The decrease in 2008 is explained not by drought, but by rainfall being more than norm. In the same year, rainfall in Shamakhi was 15 mm below the norm in winter, 40 mm above the norm in spring, 110 mm in summer, 67 mm in autumn. In Dashkasan, in 2000, the productivity decreasedsharply (6.1 c / ha) due to the moderate and severe drought in the vegetation period of the plants, and in the following years the as the degree of drought was moderate and weak, productivity increased [3].

Table 2.Drought years defined in Azerbaijan in 2008 -2017

№	Stations	Rainfall index of SPI (annual values)									
		2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1	Shaki	-0,35	0,47	0,00	0,83	0,35	-0,89	-1,89	-0,72	1,21	-1,58
2	Zagatala	-0,96	0,63	-0,42	1,37	-1,09	-0,77	-1,09	-0,36	1,01	-1,59
3	Gabala	-0,05	-2,75	0,32	1,29	-0,87	-0,98	-2,05	1,65	0,70	-0,67
4	Guba	-0,56	0,45	-0,53	0,15	-0,66	1,15	-0,94	-0,50	2,04	-1,46
5	Khachmaz	-0,98	-0,28	-0,14	-1,29	1,12	0,61	-1,90	-0,20	0,81	-1,17
6	Grız	-0,32	0,28	0,04	-0,64	-1,30	-0,40	-1,37	-1,39	-0,41	-1,88
7	Ganja	-1,14	-0,51	0,80	-0,44	-1,83	-1,73	0,20	0,16	0,83	-0,70
8	Agstafa	-1,80	0,23	0,60	-1,03	-1,04	-0,96	-0,69	0,49	-0,21	-1,60
9	Gadabay	0,42	1,26	1,63	1,84	0,76	0,31	0,39	-0,62	0,39	-0,91
10	Lankaran	-0,17	-0,82	-0,48	1,75	-0,43	0,17	0,03	1,92	1,44	-0,15
11	Astara	-0,67	-1,82	-0,12	0,61	-0,95	0,00	-0,35	1,73	0,68	-1,18
12	Yardimli	-1,64	-1,11	-0,86	1,38	0,21	-0,85	-0,76	0,82	0,57	-1,03
13	Lerik	-0,64	-1,62	-1,67	1,05	0,56	-1,01	0,04	0,24	1,28	-0,06
14	Kurdamir	0,38	0,43	-0,22	2,15	0,07	1,12	-1,22	-0,57	0,39	-1,34
15	Goychay	-0,47	-0,51	1,29	1,08	-1,71	-0,86	-1,62	-0,19	-0,62	0,08
16	Yevlakh	-1,41	0,25	-0,11	0,02	-1,08	-1,59	-1,67	0,21	-0,32	-1,14
17	Jafarkhan	0,37	0,95	0,77	0,40	-0,63	0,12	-1,28	0,24	1,40	-2,04
18	Nakhchivan	-1,67	0,94	0,19	1,59	-0,98	1,04	-1,03	0,37	-0,42	-0,59
19	Ordubad	-1,77	-1,44	-0,40	-1,16	-1,09	-0,95	-0,77	0,75	0,09	0,15
20	Baki	0,55	0,05	1,08	1,92	0,74	0,90	0,32	0,67	1,53	0,75
21	Mashtaga	-0,25	-0,98	-0,28	1,53	0,75	-0,18	-1,07	0,48	2,13	-0,19

Drought influence on water flow

Drought is one of the main indicators in river flow. Regardless of the degree, any drought should have a slight impact on the various flow parameters. Thus, different flow characteristics were 23-36% less than the corresponding flow norm in 1971. As in 1966, the impact of meteorological drought on minimal water expenditure in 1971 was the strongest, while the maximum water consumption was the weakest. The empirical guarantees of minimum summer water consumption range from 70-95% for most rivers.

In 1971, climatic conditions were not favorable for the formation of river flow, but the occurrence of drying in rivers was small. An analysis of observation data shows that the rivers of some regions with weak humid conditions have dried up: the analysis of the 1971 data shows that the annual rainfall in all the settlements was 3-51% less than the norm and this figure was 27% on average.

One of the reasons of decrease in river flow in 1971 was the drought occurred in 1970.

The water of the main river system of Azerbaijan – Kur decreased three times. That's why, the area of irrigated soils and electricity generation have diminished, and many small rivers dried up.

Table 3 shows, minimal winter water flow ratio to annual flow in 4 regions of Azerbaijan. Table 3 summarizes trends of annual flow rates of minimal winter flows in 4 regions of Azerbaijan. Trend is not noticeable only for the rivers of Lankaran natural district. The increase in winter water flow ratio to annual flow is related to the increase in temperature during cold periods,which in turn increases the number and duration of mild weather, decreases soil degradation and underground wateris more commonly used [1].

As winter flow increases because of spring flow, the ratio of maximal flow to annual flow in the noted 4 regions, sometimes decreases, thus, negative trends in 3 regions statistically are noticable (Table 3). Positive, but statistically not noticable rivers are in Lankaran natural district.In the rest of the region, except the north-east region of the Greater Caucasus, the ratio of the minimum monthly flows of summer-autumn to annual flow increases.

Table 3.Evaluation of linear trends of the module coefficient ratios of different flow characteristics in the regions of Azerbaijan.

Region	Period	$Q_{min.wint}/Q_{year}$				$Q_{min.sum}/Q_{year}$				Q_{max}/Q_{year}				$Q_{min\,wint}/Q_{min.sum}$			
		Trend sign	R^2	R	σ_R	Trend sign	R^2	R	σ_R	Trend sign	R^2	R	σ_R	Trend sign	R^2	R	σ_R
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
The north-east slope of the Greater Caucasus	1950 - 2014	+	0,159	**0,40**	0,107	0	0,027	0,16	0,134	m	0,817	**0,46**	0,124	+	0,184	**0,135**	0,111
The south slope of the Greater Caucasus	1950 - 2014	+	0,349	**0,50**	0,095	+	0,056	**0,24**	0,120	m	0,151	**0,39**	0,108	+	0,063	**0,25**	0,119
The north-east slope of the Minor Caucasus	1951 - 2014	+	0,141	**0,38**	0,118	+	0,009	0,09	0,136	m	0,301	**0,55**	0,096	+	0,068	**0,26**	0,128
The south-east slope of the Minor Caucasus Nakhchivan	1960 - 1998	+	0,254	**0,50**	0,131	+	0,051	0,23	0,149	m	0,065	0,25	0,152	+	0,317	**0,56**	0,111
Lankarannat uraldistrict	1950 - 2014	0	0,001	0,03	0,127	+	0,065	**0,25**	0,119	+	0,027	0,16	0,124	m	0,017	0,13	0,125

Note: thefigureswritteninboldare striking values of correlation coefficient;m – negative trends; 0 – no trend.

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