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Climate Change and Barley Production in Afghanistan: A Case Study of Injil District, Herat Province

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ABSTRACT

The research focuses on barley output in the Injil District of Herat Province, Afghanistan, and the influence of climate change between the years 2008-2017. Over the previous 10 years, the study's findings imply a relative rise in both mean maximum and mean minimum temperature, as well as a relative drop in yearly precipitation. According to the farmers in the District, the prevalence of the pest and disease is quite low and has caused no harm to the area of barley production. Climate change (temperature and precipitation) has a somewhat positive impact on barley productivity, according to the research. The research also discovered a statistically negative association between temperature and barley productivity, finding that a comparatively higher temperature resulted in a considerable increase in barley yield when the best pest and disease-resistant variety was employed and the weather was favourable. Precipitation and barley yield were also shown to have a statistically negative association, according to the research. The consequence is that when precipitation relatively decreases, the area of barley production increases, since another factor impacting barley output is the use of stream water, wells, and kariz to remove water shortages for irrigation, as well as the use of disease and pest-resistant cultivars.

Keywords- Climate change, temperature, Injil, barley production.

I. INTRODUCTION

Climate change has an impact on agriculture and water, as well as food security and livelihoods for a major segment of the rural population in developing nations. The most optimistic scenario (RCP4.5) predicts Afghanistan rising by 1.5°C until 2050, then stabilising, and then increasing by 2.5°C until 2100. The pessimistic (RCP 8.5) scenario, on the other hand, predicts severe warming of around 3 °C throughout the whole nation until 2050, with additional warming of up to 7 °C by 2100. (National Environmental Policy Act and United Nations Environment Programme, 2015).

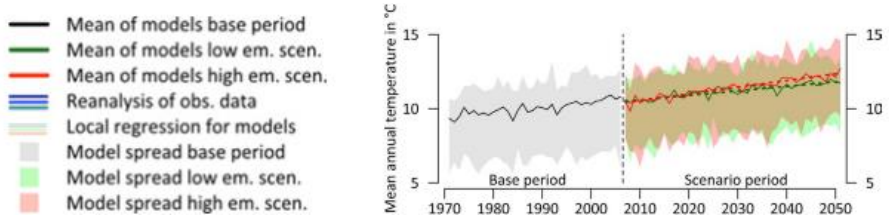

Figure 1: Seven distinct regional climate models' mean annual temperature for Afghanistan, as well as the RCPs 4.5 (green) and 8.5 (red). (National Environmental Policy Act) and United Nations Environment Programme, 2015)

Mean rainfall over the same period has Spring precipitation has dropped at a rate of 2% each decade on average, owing mostly to declines in winter precipitation. In recent years, a confluence of circumstances has resulted in a protracted drought. (Savage and colleagues, 2009).

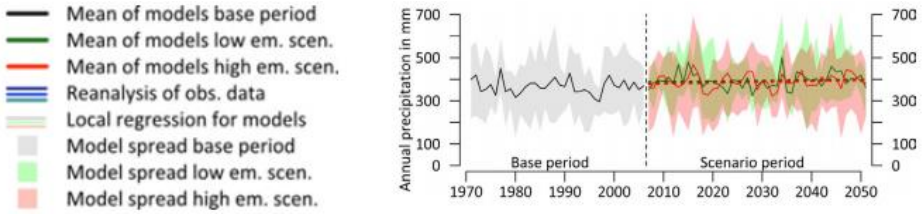

Figure 2: Annual precipitation trends in Afghanistan from seven distinct regional climate models under RCP 4.5 (green) and 8.5 (orange) (red). Original source: (NEPA and UNEP, 2015).

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II. RESEARCH OBJECTIVES

The study's main goal was to determine the influence of climate change on barley output in Herat's Injil area. The study's goals were to:

1) examine the trajectory of climate change in the Injil District of Herat during the last ten years (2008-2017).
2) Investigate the impact of climate change on barley production.
3) Find out how farmers feel about climate change's impact on barley output.

Research Questions

The purpose of the research was to discover answers to the following questions:

1) What has been the trend in climatic change in Herat's Injil area during the last ten years (2008-2017)?
2) How is the district's barley output affected by climate change?
3) What impact does climate change have on barley output, according to farmers?

Study Area

The purpose of this research was to determine the impact of climate change on barley production in the Injil District of Afghanistan's Herat Province.

Injil is a district in Herat Province, Afghanistan's northwest. It encompasses Herat City and is bordered on the north by Kushk District, the east by Karukh District, the south by Guzara District, and the west by Zinda Jan District. Herat Province's Injil district has a total area of 1333 square kilometres, including 17000 hectares of agricultural land. There are 486 small and significant communities in the district. Injil is known for its cereal crops such as wheat, rice, barley, bean, pea, cotton, and vetch, as well as fresh and dried fruits such as raisins, grapes, peaches, apricots, mulberries, apple, and pomegranate. Onions, tomato, cucumbers, carrots, turnips, and garlic are among the vegetables grown there. River water from the Hariroad River, wells, springs, and kariz are used for irrigation.

The climate of Injil is mild, with rainfall in the early winter and early spring. Winter is freezing, while spring is scorching and dry. This makes the conditions ideal for cultivating a variety of high-quality grain crops, particularly barley. The Harriroad River is Injil's primary supply of irrigation water.

Research Approach

The mixed methods approach was used in this study. To better comprehend a research topic, a mixed method study collects, analyses, and "mixes" quantitative and qualitative research and methodologies in a single study. Creswell (2010) argues that combining quantitative and qualitative data provides a greater grasp of a study topic than either kind alone.

Sampling Technique

Both probability and non-probability sampling strategies were utilised in the study to ensure that enough data was collected to allow the researcher to generalise the primary findings. Individual barley producers from several villages in the area served as the study's unit of analysis. However, important informants such as Agricultural Extension Officers and the Plant Pathology Officer of the District's Agriculture Directorate were consulted. Out of 486 communities in the Injil area, 26 were chosen at random for the research, and from each village, a total of 5 barley producers were chosen at random for interview in collaboration with the village chief.

Source and Method of Data Collection

The respondents of the communities provided both quantitative and qualitative data. The data for this research came from both primary and secondary sources. The Meteorological Department of the Urdokhan Agricultural Research Station of Herat Directorate of Agriculture, Irrigation, and Livestock provided primary data, while the Meteorological Department of the Urdokhan Agricultural Research Station provided secondary data (DAIL).

III. DATA PROCESSING AND ANALYSIS

The data for this research was statistically and qualitatively processed and evaluated. With the use of the Statistical Package for Social Science software and the Microsoft Excel software, the quantitative data was examined using descriptive statistics. Cross-tabulation and graphs are examples of analytical tools.

The research used secondary data (climate and barley production data) spanning more than ten years (2008-2017). The climatic data was utilised for trend analysis, and the consequences of climate change were analysed using a combination of the climate data and barley production data. Temperature and rainfall were the variables considered in the trend analysis.

The correlation function in SPSS Statistical Software version 24 was used to investigate the relationship between climatic conditions and barley production in order to investigate the impact of climate change on barley production as well as to properly analyse and interpret the data.

IV. RESULT

Trend Analysis of Climate Change

A linear trend line usually shows better how a parameter is increasing or decreasing at a steady rate, so the trend lines were drowned to show how the climatic parameters (temperature, precipitation) have undergone up and down variation within stipulated years for better studying of the climatic condition in the last ten years.

The trend analyses clearly reveal that, over the last ten years, both mean minimum and mean maximum temperatures have risen, while precipitation has decreased.

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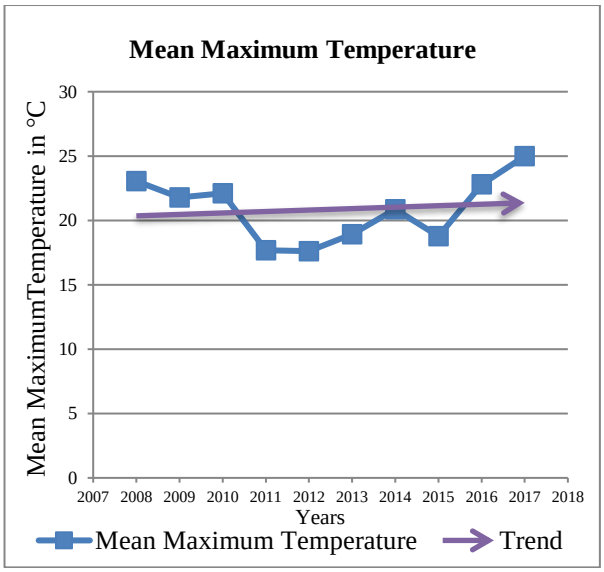

Figure 3: Injil District, Herat Province, Mean Maximum Temperature Trend (Source: UARS, 2018).

Figure (3) shows how the average maximum temperature has changed over the last 10 years (2008-2017). In comparison to previous years, the district's mean maximum temperature largely oscillated and declined, notably in the years 2008-2009. According to the graph, mean maximum temperature grew from 2009 to 2010, then declined significantly from 2010 to 2011, then increased from 2011 to 2014, then decreased from 2014 to 2015, and then abruptly soared from 2015 to 2017. The time series data clearly shows that 2017 had the greatest mean maximum temperature of 24.9ºC.

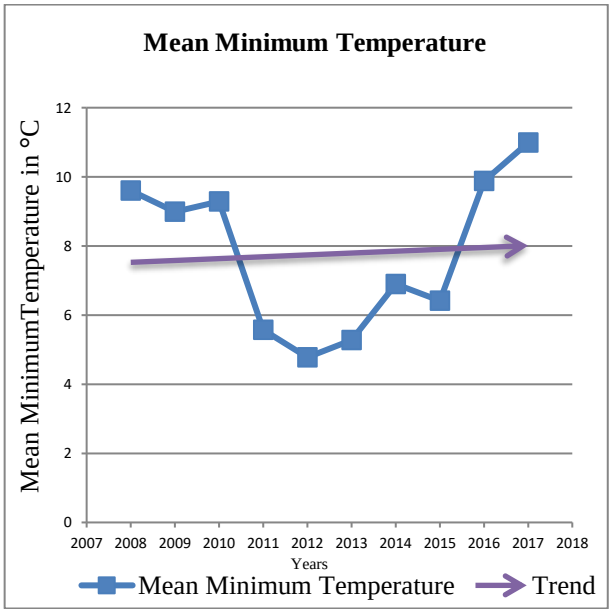

Figure 4: Injil District, Herat Province, Mean Minimum Temperature Trend (Source: UARS, 2018).

The mean lowest temperature trend in the district from 2008 to 2017 is shown in Figure (4). In the Injil District of Herat, the mean minimum temperature has shown some variation over the last ten years (2008-2017).

The figures indicate that the mean lowest temperature dropped from 2008 to 2009, then rose from 2009 to 2010. Following that, there was a significant drop from 2010 to 2012, followed by an uptick from 2012 to 2014, a drop from 2014 to 2015, then a dramatic increase from 2015 to 2017.

The time series data clearly shows that 2017 had the greatest mean low temperature of 10.9ºC.

This shows that the district's temperature is rising. A rise in the minimum temperature of crops in general has the effect of affecting the annual cycle of the plant, barley growth, and disease not discovered and not harmed to the barley producing area.

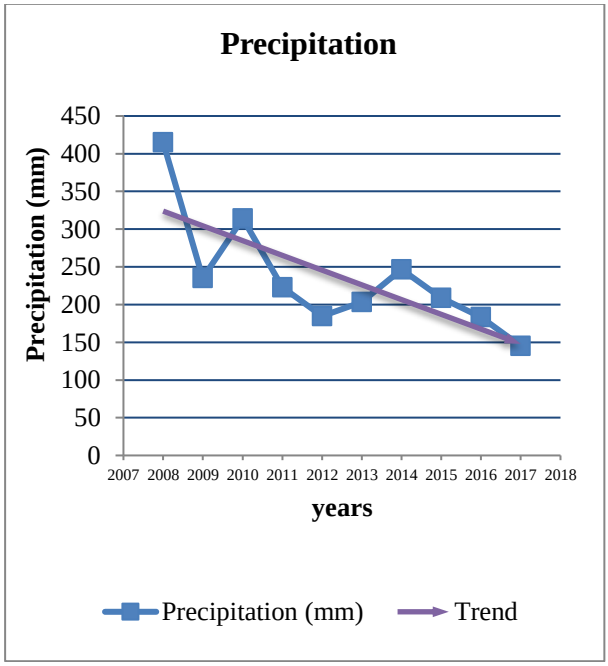

Figure 5: Annual Precipitation Trends in Herat Province's Injil District (Source: UARS 2018).

Figure (5) depicts the precipitation variability trend in the study area in great detail. Over the previous 10 years, the yearly precipitation quantity has been steadily dropping. Annual precipitation declined dramatically from 2008 to 2009, but somewhat rose from 2009 to 2010. After that, annual precipitation decreased from 2010 to 2012, then increased from 2012 to 2014, and then sharply decreased from 2014 to 2017.

The picture clearly shows that precipitation varied significantly across the study period (2008-2017), with the largest precipitation (415mm) occurring in 2008. In general, total annual precipitation has decreased during the previous ten years, indicating a downward trend in rainfall in the region.

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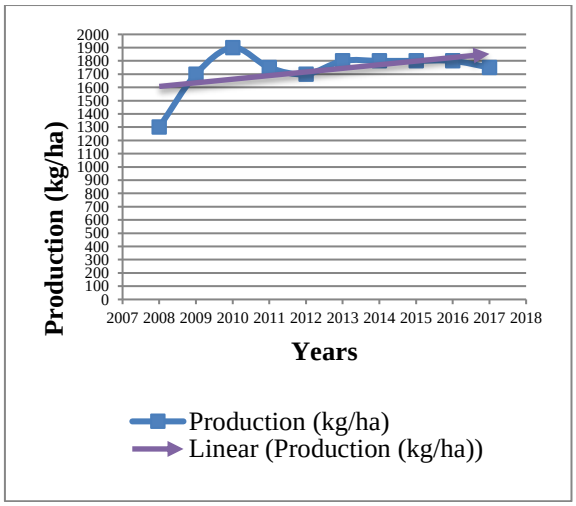

Figure 6: Trends in Barley Production in Herat Province's Injil District (Source: UARS, 2018).

Figure (6), The district's production generally fluctuated, increasing from 2008 to 2010, then dramatically decreasing from 2010 to 2012, then increasing from 2012 to 2013 and then decreasing from 2013 to 2017. The time series data clearly shows that 2010 had the greatest output of 1900kg/ha.

Effect of Climate Change on Barley Production

When looking at the statistics on barley production as well as the quantity produced in the Injil District during the previous ten years, it is obvious that barley output has increased in the district from 2008 to 2017. Many variables influence the area under cultivation, as well as the district's yield. Climate change has been shown to have a direct and indirect impact on barley output in the area.

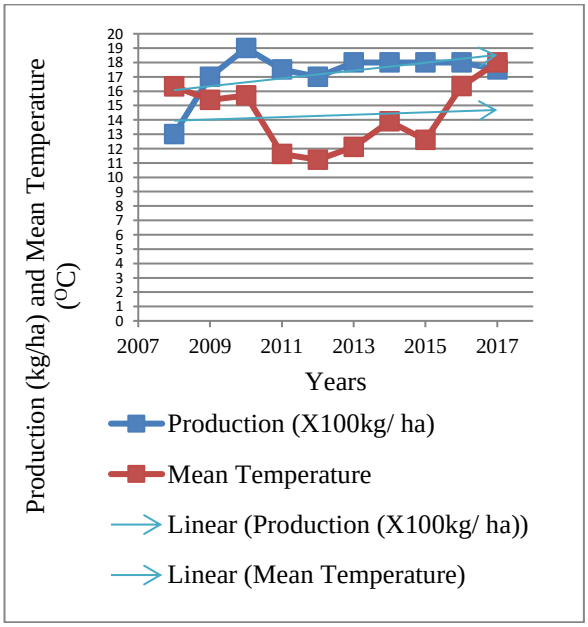

Figure 7: Injil District, Herat Province, Production in Relation to Mean Temperature.

Figure (7) depicts the temperature-production relationship from 2008 to 2017. Production in the district largely oscillated and climbed from 2008 to 2010, then significantly declined from 2010 to 2012, then increased from 2012 to 2013, then decreased from 2013 to 2017, which might be due to other variables interacting with the area's temperature. We achieve the best area of barley production by considering the influence of several aspects (such as soil type, regular weeding, excellent irrigation, good sun solar for irrigation, usage of disease and insect resistant varieties, and use of Hariroad river water for irrigation). The trend line clearly shows that barley output has grown over the previous 10 years.

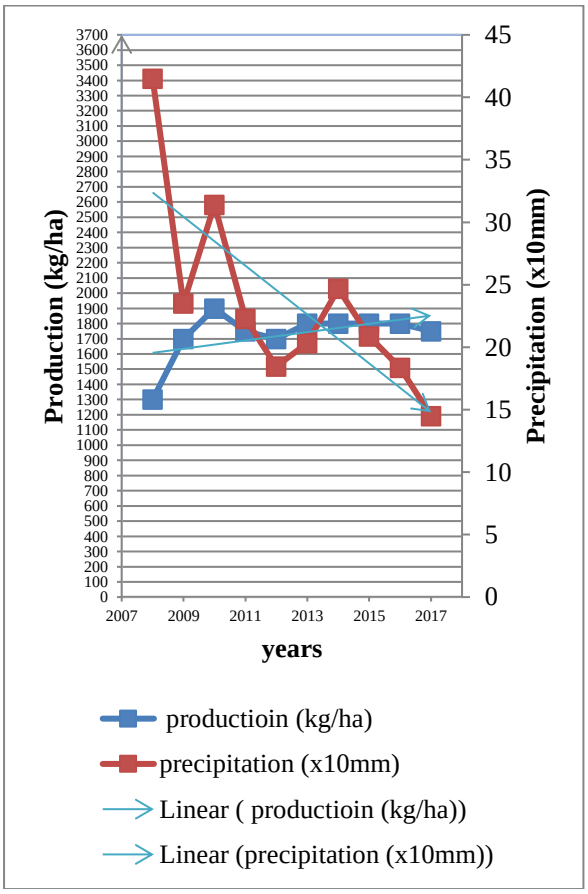

Figure 8: Injil District, Herat Province, Production in Contrast with Precipitation.

In the previous 10 years, the quantity of yearly precipitation had an impact on barley output in the district, as shown in Figure (8). We can observe that when precipitation decreases, production increases. It is clear that the district's production has changed in relation to the amount of precipitation, and other factors have an impact on barley production in the district, such as the decrease in relative humidity as precipitation decreases, and most diseases are not found or damaged to barley production, the use of deep wells, solar water, Hariroad river water for irrigation, springs and kariz, and the use of the Salma Dam.

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In order to investigate the association between climatic change and barley production, correlation in SPSS 24 was utilised to analyse the data accurately and get a decent result. Temperature and rainfall data were used to demonstrate the relationship between these two factors and the area of barley production in the region. It is obvious from the Pearson product – moment correlation data that there is a link between the mean temperature and production in the district, as well as the mean precipitation and production.

Table 1: Injil District's Precipitation, Mean Temperature, and Production Relationship.

Correlations				
		Production	Mean Temperature	Precipitation
Production	Pearson Correlation	1	-0.209	-0.632
	Sig. (2-tailed)		0.562	0.050
	N	10	10	10
Mean Temperature	Pearson Correlation	-0.209	1	0.206
	Sig. (2-tailed)	0.562		0.568
	N	10	10	10
Precipitation	Pearson Correlation	-0.632	0.206	1
	Sig. (2-tailed)	0.050	0.568	
	N	10	10	10

The correlation finding demonstrates that the mean temperature and the production of (r = -0.209) in the district have a somewhat negative association. It implies that there was an influence of mean temperature on barley output in the area from 2008 to 2017.

The Pearson product moment correlation table clearly shows that the district's link between precipitation and production is negative, with a value of -0.632. It indicates that the impact of precipitation was minimal, and farmers were able to alleviate water shortages for irrigation barley by using stream water, wells, and kariz, as well as the impact on barley output in the region.

Table 2: Production, Mean Temperature, and Precipitation Descriptive Statistics of the Data.

Descriptive Statistics			
	Mean	Standard Deviation	N
Production (kg/ha)	1730.00	161.933	10
Mean Temperature (ºC)	14.32	2.346	10
Precipitation (mm)	235.88	77.404	10

The quantity of precipitation in the previous 10 years has a standard deviation of 77, according to the descriptive data of precipitation. The results show that by decreasing the amount of precipitation in the district, barley production increased in the last ten years from 2008 to 2017, because another factor affecting barley production is the use of stream water, wells, and kariz to eliminate water shortages for irrigation and the use of disease and pest resistant varieties.

Result of Questionnaires Interview with Farmers Perception in Injil District

Different types of barley are produced in this region, as shown in Figure 9, that are resistant to diseases and pests, have a good adaptability to the environment, and have a higher market demand.

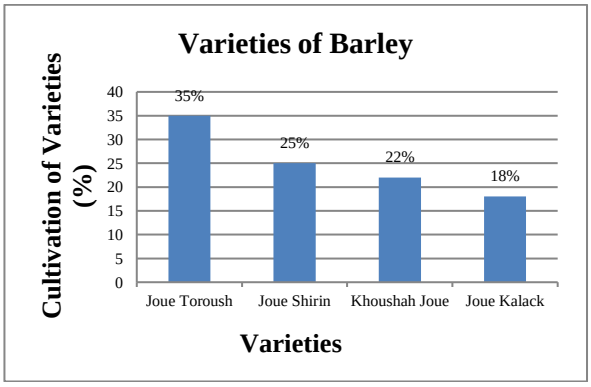

Figure 9: Barley varieties in the Injil District in Herat Province. (Source: Survey interview).

In this district, all farmers utilise all available water resources to irrigate their land: around 75% of stream water, 20% of well water, and 5% of kariz, as

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shown in Figure 10. The quantity of precipitation has a significant impact on barley growth and development, as well as productivity. The precipitation has been minimal in recent years, which has had an impact on the area of barley cultivation. Water shortages for irrigation are addressed, and agricultural growth is boosted, thanks to the usage of Heriroad River and Salma Dam water. (Interview for a survey)

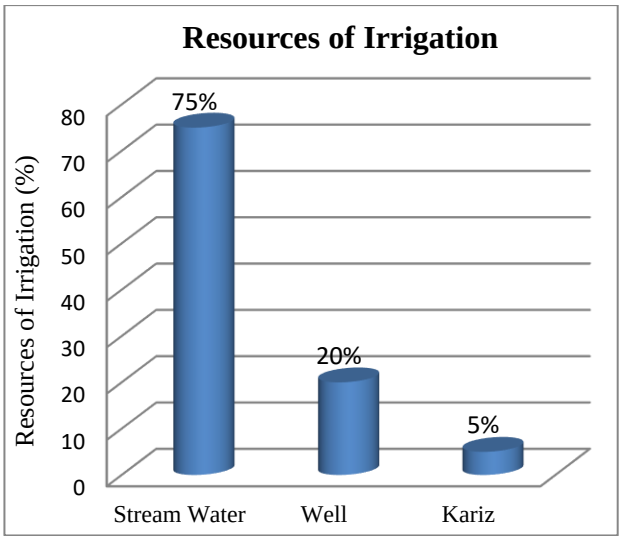

Figure 10: Irrigation Resources in Injil District, Herat Province (Source: Survey interview).

V. DISCUSSION

In order to assess the impact of climate change on barley production, the study looked at the trend of climate change and the level of inter-annual variation in the district over the last ten years (2008-2017), as well as how climatic variations affect barley production and how farmers perceive the effects of climate change on barley production.

Temperature and precipitation, both meteorological variables, have fluctuated during the previous 10 years. Within the specified years under consideration, both the mean minimum and mean maximum temperature characteristics of the region underwent some amount of volatility, according to the research (Figures (3) and (4)).

Climate change's impact on barley production has been investigated. In the 10 years from 2008 to 2017, the connections between temperature, precipitation, and production were drawn, and it was discovered that there is a link between temperature and barley production, as well as precipitation and production in the district. Figure (7) illustrates that the area for production rose as mean temperature increased in the ten years from 2008 to 2017, and the correlation result shows that there is a relatively negative relationship between the precipitation and the production of (r = -0.632) in the district.

Climate change's impact on barley production has been investigated. In the 10 years from 2008 to 2017, the connections between temperature, precipitation, and production were drawn, and it was discovered that there is a link between temperature and barley production, as well as precipitation and production in the district. Figure (8) shows that decreasing mean precipitation increased the area for production in the ten years from 2008 to 2017, because another factor affecting barley production is the use of stream water, wells, and kariz to eliminate water shortages for irrigation and the use of disease and the correlation result shows that there is a relatively negative relationship between the precipitation and the production of (r = -0.632) in the district.

VI. CONCLUSION

The major goal of this research is to get a better knowledge of climate change and its effects on barley production in the Injil area of Herat, Afghanistan. Within the specified years under consideration in the district, both the mean minimum and mean maximum temperature characteristics of the region saw some amount of volatility, according to the research. The total mean minimum and mean maximum temperatures are rising in the Injil area, according to the trend lines. The number of really cold days is decreasing in the winter, while the number of extremely hot days is growing in the summer. This demonstrates that the area's climate favours hotter days and milder winters.

Aside from that, precipitation has an inverse relationship with temperature, and the trend line indicates that precipitation has been quite low in the previous 10 years, from 2008 to 2017. The analysis of barley output and the area under barley production reveals that barley production increased in the district from 2008 to 2017.

The main reason for the increase in barley production in this area is the favourable climatic conditions, as well as the use of superior varieties such as Joue Toroush, Joue Shirin, Joue Kalack, and Khoushah Joue, which are disease and pest resistant, have a good adaptation to the environment, and have a higher market demand. The irrigation technology used to grow barley is surface irrigation. The quantity of precipitation has a significant impact on barley growth and development, as well as productivity. The precipitation has been minimal in recent years, which has had an impact on barley output. Water shortages for irrigation are removed, and the area of barley production is enlarged, thanks to the utilisation of water from the Heriroad River and the Salma Dam.

This suggests that a comparatively higher mean temperature resulted in a large increase in barley output, taking into account factors such as soil type, regular weeding, adequate irrigation, good sunlight for irrigation, and the use of disease and insect resistance

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varieties. In addition, the researchers discovered a statistically significant negative link between mean temperature and barley yield. The precipitation in this district is relatively decreased and all farmers eliminate the shortage of water for irrigation with use of 75% of Stream River, 20% of well and 5% of kariz, and its effect for barley production.

REFERENCE

[1] UARS. 2018. Climatic Data, Urdukhan agricultural Research Station, Meteorological Department, Herat Agriculture Directorate.

[2] NEPA, and UNEP. 2015. Climate change and governance in afghanistan. National Environmental Protection Agency, and United Nations Environment Program.

[3] Savage, Matthew, Bill Dougherty, Mohammed Hamza, Ruth Butterfield, and Sukaina Bharwani. 2009. Socio-Economic Impacts of Climate Change In Afghanistan. Stockholm: Stockholm Environment Institute.

[4] Survey interview. 2018. Farmers Perception, Injil, District Herat Province, Afghanistan.