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# The Variation Of Rain Fall In Kuwiat From 1962 Till 2010.

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**----------ABSTRACT----------**

*Analysis of rainfall in years and the amount of precipitate is vital in examining the arid environments where resources are scarce and unpredictable. In the study, the rainfall in years and amount of precipitation in Kuwait was analyzed using the data recorded for the year 1962 up until 2010. the purpose of the manuscript is to review the rainfall patterns in arid environment specifically Kuwait, to review and analyze the total rainy days happened in Kuwait since 1962 up to 2010 with relation to the total amount of precipitation in millimeters, to review and analyze the total rainy days per month happened in Kuwait since 1962 up to 2010, to review and analyze the total amount of precipitation in millimeters happened per month, correlating to the average total rainy days per month, and to analyze the amount of rainfall with the created 12-year intervals starting from the year 1962 up to 2010. The data showed that for every increase in the total number of rainy days per year, it is proportional to the increase in the total amount of precipitation in millimeters. Given the 49 years, starting from the year 1962 up to 2010, the rainy season of Kuwait starts in October and ends in May, while the dry season occurs from June to September. The highest amount of precipitation in millimeters occurs in the month of January. The highest total number of rainy days happened in the year 1972 with the total of 72 rainy days. The highest amount of precipitation happened in Kuwait was in the year 1976 with 242.4 millimeters, and the lowest was in the year 1991 with 13 millimeters. It can be concluded that due to climate change, there is a continuous decline in the amount of precipitation and a total number of rainy days in the long run. One of the recommendations necessary for the study is to compare and validate the gathered data to other researchers and expert teams that are fully dedicated to observing and gathering data, mainly in those arid environments, including Kuwait so that the result of the study can be confirmed whether it is the natural variations are the reason behind rainfall patterns that is happening in Kuwait, either with or without the influence of greenhouse gas. Another is to conduct Hydrological Accounting to look more into details about what is happening during the condensation and precipitation in the approximate total amount of water present in Kuwait. By conducting Hydrological Accounting in Kuwait including its nearby countries, it may result in creating multiple hypothesis aside from climate change and may also result in having a right approximation of when will be the next year of having the highest amount of precipitation in millimeters and when will be the next highest total amount of rainy days a year. A collaboration with the team experts, researchers, and other sectors who are dedicated to analyzing the hydro-climatology of Kuwait and nearby countries, and those who are well dedicated to accounting the hydrology of the country is also necessary to avoid speculations and provide intelligent hypotheses for the future study regarding the variation of rainfall in Kuwait. Collaboration with the team experts and researchers is also necessary to pinpoint what are the missing data necessary for the study. With the collaboration, there will be clarity and consistency about the data gathered with those data which were gathered by other people. With the compilation of the gathered data, the analysis regarding the variation of rainfall we are supported by different analyzed data.*

***Keywords***-*Drought, Precipitation, Kuwait, Amount of rainfall, Hydrological Accounting, arid environment, rainfall data, rainfall intensity, trend analysis, wet and dry seasons.*

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## I. INTRODUCTION

The changes in the structure and functioning terrestrial ecosystems that are now happening would be more intensifying in the near future due to the changing climate and how human activities uses land that affects the land's productivity, water regime, and biodiversity. Literature relating to the analysis of the potential effects of increasing greenhouse gas emission (GHG) concentration in the atmosphere on ecosystem function and services is extensive. The extensive literature does not usually discuss the alteration of rainfall and its probable increase in rainfall variability, which is one of the essential characteristics of global change. These alterations are also connected to the nutrient cycling, the growth of the plants, and population and community dynamics (Miranda, Padilla, and Pugnaire 1302). By analyzing the rainfall alterations and rainfall variability, it may lead to answering questions related to climate change like the probability of the next incoming storm, the amount of

rainfall next year, or predicting the dry and wet season duration and intensity. The changes in the activities of organisms like culture and traditions also explain the impact of climate change.

The country of Kuwait is surrounded by the Arabian and Syrian Deserts to the west and the Persian Gulf to its east, located in a semiarid climate zone. With a total land area of 17,820 $km^2$, Kuwait is bordered by Iraq to the north and northwest, and by Saudi Arabia in the west and south. The slope of the land is relatively flat having a slightly undulating desert plain, with an increase in slope towards the northeast. The climate characteristics of Kuwait have a desert climate with long, dry, hot summer with the usual temperature of 45 °C and a cooler winter having a possible temperature of 4 °C. During the summer, sandstorms in the country are very evident. The rainy season falls within the month of October to May with an annual rainfall less than 100 mm in an area of 100$km^2$, while the other part of the country receives between 100 and 300 mm. (Frenken 1).

The ocean and land surface evaporate water due to the heat brought by the sun's radiation, and transferred around the atmosphere by winds, forming clouds of condensation, and will fall back from the surface of the Earth and to the rivers and oceans by means of rain or snow, which completes the global hydrological or water cycle. The society and the environment are affected by the variations of precipitation in its amount, intensity, frequency, and type (e.g. Snow or rain) from year to year and over decades. With the rain, some of it soaks into the soil and give nutrients to the plants, or may cause flooding and run-off if the same amount of rainfall precipitated in a short period of time, which will leave the sails much drier after. In contrast, lack of precipitation and having an extremely high temperature in the area contributes to drying of the soil, resulting in drought. While floods can be developed around the short period of time with the great amount of rainfall, droughts are extensive and can be developed through months or years. This only means that the water cycle is very important in mitigating flooding and droughts (Donat et al. 123). Global warming, or climate change as an appropriate term, was created and induced by human activities and is very evident now in the changes of precipitation and the hydrological cycle.

There is a major impact on society, economy, ecosystems, and on human health when extreme climatic events are usually present in the environment by driving the natural and human systems much more compared to average climate. Having both observational data for research and studies specifically in Arab region focused on the analysis of changes in climate extremes is limited, and given that there is an available data for the analysis, it is not enough due to a large number of missing values. By having personal conversations to the local participant during and after the climate workshops made by the Expert Team on Climate change Detection and Indices (ETCCDI), these give researchers time to verify values or specific station characteristics especially those suspicious ones. The ETCCDI is created due to the reason that there have not been any previous analyses of the changes in climate specifically in the Arab region (Donat et al. 582).

When it comes to the economy of the country, their earnings are mainly from the petroleum merchandise export. When it comes to agriculture, including fisheries, it does not fully contribute to the gross domestic product (GDP) of the country and also does not offer an important source of employment. The population that actively contributes to the economy of the country is approximately 1.47 million (2005) composed of 74 percent male and 26 percent female. Given that the agriculture, including fisheries, does not fully contribute to the GDP of the country, 1 percent of the population that actively contributes to the economy engaged in agriculture, and these farm owners are almost all foreigners, investors, and also have another source of income. Looking into the agriculture deeper, livestock production contributes about 67 percent of total agricultural GDP, compared to plant production and fisheries with 23 and 10 percent respectively (Frenken 3). This shows that Kuwait's global contribution to the world market is their oil exports as an energy source, wherein most of the nation are dependent on it. Kuwait belongs to those countries with large crude oil reserves and one of the ten largest exporters of crude oil and oil products around the world ("Kuwait's Initial National Communications" xiv). Due to the climate of the country, the arable land area is less than 1 percent of the total land area. Moreover, due to the water scarcity, this led to soil degradation and a lack of skills relevant to agriculture. As a result, Kuwait heavily relies on importing food with more than 90 percent of cereals, milk, and dairy products. In addition to imports, Kuwait also purchases fruits, fish, and meat with more than 60 percent ("Kuwait's Initial National Communications" 10).

Due to the prevailing hyper-arid climate of Kuwait, it is not favorable to any of the river systems in the country. Rivers and lakes do not permanently exist, but ravines are developed in the desert terrain wherein surface runoff occurs during the rainy season. The duration of flash floods only lasts about few hours to several days. The small percentage of the precipitation infiltrates the groundwater supply due to the high evaporation losses and high deficit in soil moisture (Frenken 4).

For those countries with dry areas, rainfall is very scarce ever since. It is a very important hydrological variable for the said place due to the population growth, economic developments, and urbanization is continuously increasing and progressing. Understanding the impact of rainfall on the ecosystem is a good move to develop an effective management strategy. It is obvious that the plant productivity in the country is primarily limited due to

inadequate availability of water (Kwarteng, Dorvlo, & Vijaya Kumar 605). With Kuwait as a highly water-stressed country, this leads to limited options offered in meeting socioeconomic needs.

Most of the studies regarding climate change have been conducted around the northern hemisphere, with temperate ecosystems and the Arctic, but it is more different to those environments that are warmer and drier. The number of studies regarding the climate change in the arid environment, specifically its rainfall frequency and intensity is very few and limited. Thus, the purpose of the manuscript is: 1) to review the rainfall patterns in an arid environment, specifically Kuwait; 2) to review and analyze the total rainy days happened in Kuwait since 1962 up to 2010 in relation to the total amount of precipitation in millimeters; and 3) to analyze the amount of rainfall in every 12 years starting from the year 1962 up to 2010. The main objective of the study is to analyze the trends in the amount of rainfall and precipitation for the year 1962 to 2010 in Kuwait. The hypothesis is that the precipitation and the amount of rainfall would change and increase through years as a result of climate change.

The analysis of the amount of rainfall and precipitation is discussed in this paper, with the seasonal changes in the amount and frequency of rain events in order to predict what will be the next amount and frequency of rain events in Kuwait.

## II. DISCUSSION

In table 1, the total rainy days per annum and the total amount of precipitation in millimeters are indicated with respect to the years of gathering data from 1962 up to 2010 to see if there is an increase or decrease in total rainy days while comparing it to other years indicated. By comparing the total rainy days

Table 1. Total rainy days per annum and total amount of precipitation in millimeters with respect to the years from 1962 up to 2010.

| Years | Total Rainy Days (per annum) | Total amount precipitation (mm) | Years | Total Rainy Days (per month) | Total amount precipitation (mm) |
|---|---|---|---|---|---|
| **1962** | 33 | 83.4 | **1987** | 44 | 75 |
| **1963** | 44 | 67.2 | **1988** | 37 | 69.5 |
| **1964** | 25 | 31.3 | **1989** | 45 | 67.3 |
| **1965** | 36 | 88.4 | **1990** | 10 | 39.7 |
| **1966** | 39 | 60.7 | **1991** | 11 | 13 |
| **1967** | 46 | 170.5 | **1992** | 27 | 105.8 |
| **1968** | 61 | 79.4 | **1993** | 39 | 190.4 |
| **1969** | 54 | 105.7 | **1994** | 35 | 109.4 |
| **1970** | 40 | 80.6 | **1995** | 36 | 155.6 |
| **1971** | 54 | 113.9 | **1996** | 38 | 187.4 |
| **1972** | 67 | 218.9 | **1997** | 43 | 215.3 |
| **1973** | 31 | 34.8 | **1998** | 21 | 111.7 |
| **1974** | 63 | 168.4 | **1999** | 32 | 168.2 |
| **1975** | 66 | 140.9 | **2000** | 33 | 80.8 |
| **1976** | 72 | 242.4 | **2001** | 28 | 127.3 |
| **1977** | 58 | 136.3 | **2002** | 36 | 141.2 |
| **1978** | 47 | 106.8 | **2003** | 33 | 152.3 |
| **1979** | 38 | 121 | **2004** | 46 | 217 |
| **1980** | 49 | 131.9 | **2005** | 26 | 187.6 |
| **1981** | 50 | 80.4 | **2006** | 38 | 114.9 |
| **1982** | 31 | 128.8 | **2007** | 20 | 77.1 |
| **1983** | 56 | 64.9 | **2008** | 19 | 43.2 |
| **1984** | 40 | 83.3 | **2009** | 28 | 110.9 |
| **1985** | 33 | 79.1 | **2010** | 23 | 35 |

per year, it can give a clearer view in analyzing the data. The total amount of precipitation in millimeters is also included to see if the total rainy days correlate to it. It is clearly seen that for every increase in a number of total rainy days happened per year; it is predictable that there is also an increase in the total amount of precipitation in millimeters.

In table 2, the total rainy days within 49 years of gathering data from 1962 up to 2010 indicated with the average total rainy days and the total amount of precipitation in millimeters with respect to months. It is necessary to indicate the total rainy days in years to make it clearer and more visible to analyze the gathered data about the increase and decrease of total rainy days. In addition to the table, the months are indicated to clearly see those months that are included in the rainy season and those months that are in the dry season. By analyzing table 2, the wet and dry seasons of Kuwait can be proven by analyzing the data that was gathered from 1962 until 2010. With the data from table 1, it can be compared to the data presented in figures 1 and 2 to support the assumption that the climate change mainly contributes to the decrease in the total amount of precipitation and total rainy days per annum. The rainy season of Kuwait starts in October and ends in May, while the country dry season occurs from June to September. The Figures 3 and 4 shows the total rainy days and the total amount of

precipitation in millimeters, both per month. In Figure 4, it is shown that the highest total amount of precipitation in millimeters occurs in the month of January.

In figure 1, The total rainy days per annum are shown from the year 1962 up to the year 2010 (49 years collected data). The total rainy days per annum was created by combining the total number of rainy days per month that happened in the specific year to compare and see the trends on the total rainy days per year in Kuwait. In the year 1962, the total rainy days in the whole year is 33 days, compared to the end year 2010 with only 23 total rainy days happened in a year. The highest total rainy days happened in the year 1976, followed by 1972 with a total of 72 and 67 rainy days happened in a year. In the years 1962 up to 1976, there is a gradual increase in a total number of rainy days from years 1962 to 1975. After the year 1976, the decline in total rainy days happened in a year is visible up until 2010. The lowest total rainy days happened since the said years was in the year 1990, followed by 1991, with 10 and 11 total rainy days in a year.

In figure 2, the total amount of precipitation in millimeters is measured in Kuwait also started from the year 1962 up to 2010. The total amount of precipitation was created by combining the total amount of precipitation in millimeters per month that were happening in a year to compare and see the trends in the total amount of precipitation in millimeters per year. With the created results, it can be compared to the

Table 2. Total rainy days within 49 years of gathered data from 1962 to 2010 with the average total rainy days and total amount of precipitation in millimeters with respect to months.

| Month | Total rainy days in 49 years (1962-2010) | Average | Total amount precipitation (in mm) |
|---|---|---|---|
| **January** | 347 | 7.2 | 1361.2 |
| **February** | 279 | 5.8 | 706.1 |
| **March** | 320 | 6.8 | 748.8 |
| **April** | 285 | 6.2 | 598 |
| **May** | 125 | 3.8 | 163.5 |
| **June** | 2 | 2 | 0 |
| **July** | 0 | 0 | 0 |
| **August** | 0 | 0 | 0 |
| **September** | 0 | 0 | 0 |
| **October** | 58 | 2.9 | 116.3 |
| **November** | 223 | 5.7 | 776 |
| **December** | 340.9 | 7.9 | 1010.9 |

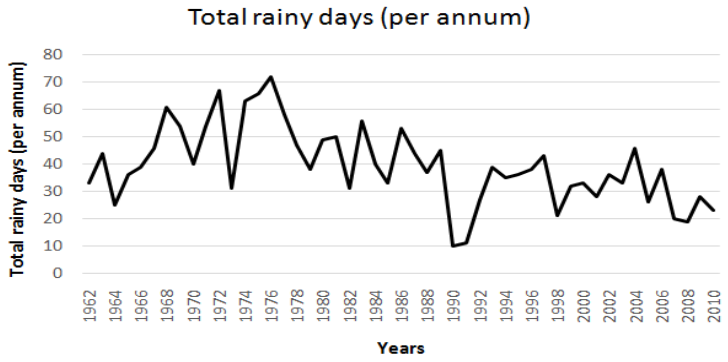


Figure 1. Total rainy days per annum since 1962 until 2010 in Kuwait.

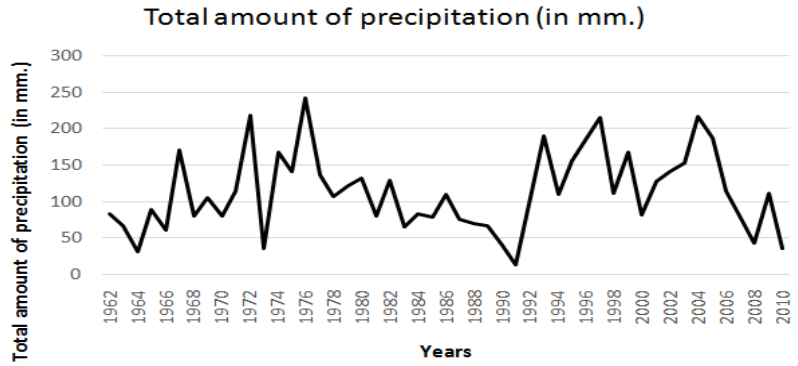


Figure 2. Total amount of precipitation in millimeters in Kuwait with respect to the years, starting from 1962 up to 2010.

total rainy days happened in a year in Kuwait to see the correlation. In figure 2, the amount of precipitation in the starting year 1962 was 83.4 millimeters and ended with the year 2010 having the total of 35 millimeters. Comparing the two figures, the trend is well correlated with the total rainy days per annum with the total amount of precipitation in millimeters. After the year 1976, there is a visible decrease in the total amount of precipitation happened in Kuwait. The highest total amount of precipitation in millimeters was in the year 1976 with 242.4 millimeters. The lowest total amount of precipitation in millimeters was in the year 1991 with 13 millimeters only.

Comparing figures 1 and 2, it is clearly shown that the total amount of precipitation in millimeters and the total rainy days are well correlated. Focusing on the highest and lowest extremes in the figures, it can be concluded that 242.4 millimeters of precipitate happened after 72 total rainy days in the year 1976 and there were 13 millimeters of precipitate happened after 11 total rainy days in the year 1991. Given that there is a dry and wet season in Kuwait, the possibility of having long wet season has been possible yet minimal in the total amount of precipitation in millimeters given that Kuwait has the arid environment. It can be concluded in the figures 1 and 2 that there is a decline in the total amount of precipitation and total rainy days from 1976 up to 2010 due to climate change. Given the results from these figures, the assumption that the climate change mainly contributes to the continuous decline of the total amount of precipitation and total rainy days per annum must be validated and supported by providing more data similar to the temporal dimension presented in figures 1 and 2.

In figure 3, the total number of rainy days per month in Kuwait is shown to support table 2 wherein the highest total number of rainy days within the 49 years of gathered data falls in the month of January. Figure 3 also shows that the start of the wet season lies on the month of October and ends in May, while the remaining months (June, July, August, and September) are included in the dry season showing that these months have an absolute zero total number of rainy days.

In figure 4, the total amount of precipitation from years 1962 to 2010 in millimeters was compared to the amount of precipitation per month in Kuwait to show which month has the highest total amount of precipitation, supporting the data from table 1. Having the figure, it can clearly see that the month of January is a far higher total amount of precipitation compared to those months which included in the wet season. May and October are the months showing the transition from wet to dry seasons and vice versa. It is clearer in the figure that there is an absolute zero total amount of precipitation during the dry season.

In figure 5, the four 12-year intervals of total rainy days per annum starting from the year 1962 up to 2010 in Kuwait was created and compared to see the trend. In the first 12-year interval (1962 to 1973), the total rainy days per annum is fluctuating, but there is a gradual increase. In the second 12-year interval (1974 to 1985), it is shown that it started with the highest total number of rainy days compared to other 12-year intervals. But going to the post part of the said interval, it is declining. In the third 12-year interval (1986-1997), it has the least number of total rainy days compared to other 12-year intervals. In the last 12- year interval (1998-2010), it has the least average total number of rainy days per annum compared to the other three 12-year intervals. Combining the last two 12-year intervals (1986 to 1997, and 1998 to 2010), the total number of rainy days per annum is declining and have no sign of an increase in the said variable.

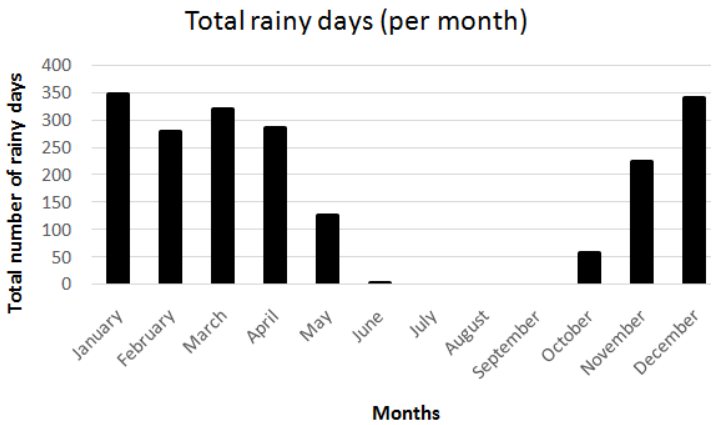


Figure 3. The total number of rainy days per month in Kuwait

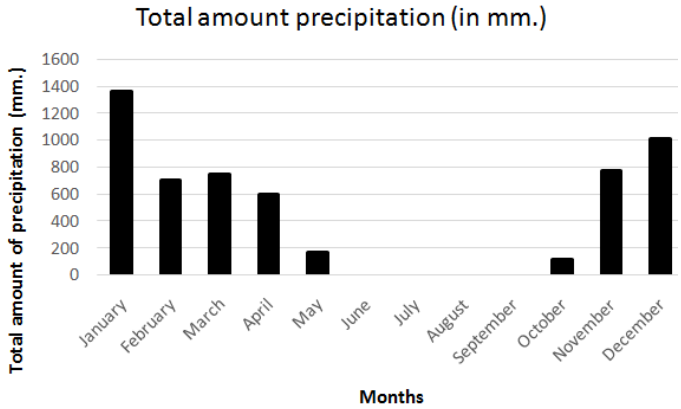


Figure 4. Total amount of precipitation from years 1962 to 2010 (in mm.), comparing the amount of precipitation per month in Kuwait

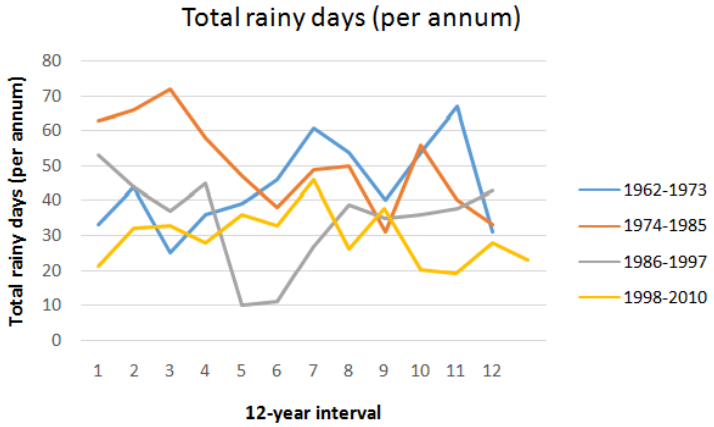


Figure 5. Four 12-year interval of Total rainy days per annum from years 1962 to 2010 in Kuwait.

## III. RESULTS

The patterns of rainfall in Kuwait shift with wet and dry seasons, wherein the dry season lies on the month of June, July, August, and September has a no rainfall at all, while the wet season lies on the month of October to May having a minimum precipitate of 163.5 millimeters and a maximum of 1361.2 millimeters. By having an analysis of the rainfall patterns from 1962 up to 2010, Kuwait faces an altering rainfall pattern wherein there is a gradual decrease of the total amount of precipitation happening in the country. The observation is, instead of having patterns in which the wet season gets wetter and the dry season get drier, an evident scenario is that only in the dry season is getting drier with a gradual decrease of the total amount of precipitation in the long run. Having this evident scenario throughout 1962 up to the present, it can be concluded that climate change greatly contributes to the changes in rainfall patterns in Kuwait. One of the recommendations necessary for the study is to compare and validate the gathered data to other researchers and expert teams that are fully dedicated to observing and gathering data, mainly in those arid environments, including Kuwait so that the result of the study can be confirmed whether it is the natural variations are the reason behind rainfall patterns that is happening in Kuwait, either with or without the influence of greenhouse gas.

The total rainy days happened in Kuwait since 1962 up to 2010 is getting slimmer in the long run. Given the fact that Kuwait belongs to the arid environment, the total number of rainy days per annum is getting lower, and there is no evident increase after the year 1976. Analyzing the total number of rainy days per annum happened in Kuwait in relation to the total amount of precipitation in millimeters, there is no valid reason for an increase in a total number of rainy days since the precipitation happening in Kuwait from the year 2004 is continuously declining. One recommendation appropriate for the study is to conduct Hydrological Accounting to look more into details about what is happening during the condensation and precipitation in the approximate total amount of water present in Kuwait. By conducting Hydrological Accounting in Kuwait including its nearby countries, it may result in creating multiple hypothesis aside from climate change and may also result in having a right approximation of when will be the next year of having the highest amount of precipitation in millimeters and when will be the next highest total amount of rainy days a year.

In analyzing the amount of rainfall in every 12 years, starting from the year 1962 up to 2010, the four 12-year intervals was created which focuses on the total number of rainy days per annum since a total number of rainy

days per annum is proportional to every increase and decrease of the total amount of precipitation in millimeters. In it clearly seen that even though the interval was created to analyze with, it is clearly seen that the total number of rainy days is gradually decreasing over the years and therefore it can be concluded that there is the least hope in the increase in the amount of rainfall. On the brighter side, it can be concluded that if there will be an increase in the amount of rainfall, then it will take more another 12 years to wait for the higher and acceptable total amount of rainfall in Kuwait. The recommendation appropriate for this is to collaborate with the team experts, researchers, and other sectors who are dedicated to analyzing the hydro-climatology of Kuwait and nearby countries, and those who are well dedicated to accounting the hydrology of the country to avoid speculations and provide intelligent hypotheses for the future study.

The hypothesis that the precipitation and the amount of rainfall would change and increase through years as a result of climate change is not proven in the study, and cannot form a firm conclusion about whether the climate change or other variables are the reason behind the declining precipitation and the amount of rainfall. With the decline of the amount of rainfall and precipitation in millimeters given that Kuwait is in the arid environment, it can be concluded that the study is lacking other data which is necessary in analyzing the result of the study, for example, is the intensity of temperatures within the year 1962 up to 2010 wherein the sudden increase in temperature of the country will greatly contribute to the process of condensation of water. If the temperature in the environment is said to be very high, this may result in the increase in evaporation of the water and decrease in water precipitate. By having other data for the study, it may lead to the firmness of having the conclusion that climate change greatly contributes to the variation of rainfall in Kuwait. Collaboration with the team experts and researchers is also necessary to pinpoint what are the missing data necessary for the study. With the collaboration, there will be clarity and consistency about the data gathered with those data which were gathered by other people. With the compilation of the gathered data, the analysis regarding the variation of rainfall we are supported by different analyzed data. As of now, the study is concluded that throughout the said years (1962-2010), the amount of rainfall and precipitation in millimeters is gradually declining.

One of the limitations of the study is that the data needs to be validated among the expert teams who were focusing on the variability of rainfall in Kuwait and also to clarify if the gathered data is similar to the data that was gathered by other people to employ similarities of the data and will lead to a multiple results which will be beneficial to the analyses of the climate of the Kuwait. Also by having multiple data that can be relatable to the variation of rainfall is highly necessary for further analysis of variation of rainfall in Kuwait, for example, is the processes involved in the changes of precipitation in which the human activities are the main reason in intensifying the state of climate change like burning of fossil fuels, wherein the burnt fossil fuels contributes to changing the composition of the atmosphere by addition of carbon dioxide and aerosols. As what is stated in the discussion, climate change can be the reason for the decline in the rainfall and precipitation in Kuwait, but it is possible. Another variable that may lead to a conclusion that the climate change is the reason behind the decline in the precipitation and a number of rainy days is the energy constraints wherein evaporation needs the energy to contribute to the hydrological cycle. An increase in surface evaporation depends on the available energy in the energy cycle. This point of view is usually underestimated in conducting the study related to environmental analysis.

As what is stated and from above, the total amount of precipitation and a total number of rainy days per annum is very vital in having an analysis of rainfall variation in Kuwait, and fortunately, many researchers and teams are getting interested in conducting research similar to these. Maps of precipitation are now available and easy to, access to, whether it is daily or hourly. Maps of precipitation across the globe can be accessed, and it is usually updated every 3 to 6 hours. Given to this kind of advanced technology, an hourly precipitation analysis should be taken into consideration and should be available in the near future. Given that the hourly precipitation analyses are available soon, it will be beneficial to investigate and analyze the intensity and frequency of precipitation across various climate regions. One of the future challenges of Kuwait is mainly in its amount of precipitation and number or rainy days that they will encounter soon. To have an analysis further, there should be a non-intermittency, comparison between land and ocean, and must have a variety of datasets that relate to the hydrological variables.

In terms of intermittency, it is clearly seen that given in the arid environment, most of the time it does not precipitate throughout the month or even months. If it is the rainy season, it is also seen from the study above that the total number of rainy days is also lower. By having hourly values or data sets related to the variability of rainfall, then it may give another hypothesis or theory that may lead to an answer to the imminent scenario. In the available data for the study, it can be stated that intermittency was employed along the 49-years of gathered data because the data has not been validated. If the data is well-validated, then look for another reason behind the variability of rainfall. The validity of the data is necessary to make the study move valid and sound, especially for this kind of research. If intermittency is unavoidable, then set a margin of error or percent error in validating the available data to ensure the precision and accuracy of the available data and the result.

When it comes to the land and ocean, it must be compared to discuss first the water availability in the area.If the water availability in the area is lesser, then it must be concluded that due to the scarcity of water in the surroundings leads to lesser precipitation. By having specific details about the water availability of the country, then it can be compared to the gathered data. Given that Kuwait lies near the Persian Gulf, which is an extension of the Indian Ocean, then there must be a factor on why the amount of precipitation in Kuwait is declining through the years. With the data of temperature in the location which affects the precipitation, there is a huge difference in water availability and can be projected to change.

By having only two datasets containing the total number of rainy days per month and the total amount of precipitation in millimeters, it is not messy to deal with, and two came up with a possible hypothesis and the result, but it lacks substance and an explanation on determining the variability of rainfall in Kuwait. By having a variety of datasets in analyzing the variability of the rainfall in Kuwait, the study will be messy, but after a rigorous investigation with proper employment of techniques and the formulation of analyses, then the study will have a more substance and can give further explanation to the variables that are being studied. Also, having a variety of datasets would lead to the formulation of different models necessary for the analysis of the study and may contribute to those researchers who are needing the analyses of data. In addition, there will be an enough confidence in presenting the results shown in the formulated model because it is well-supported by the multiple data.

Overall, it is clearly shown and can be stated that the reason behind the variation of rainfall in Kuwait is due to the worsening state of climate change and it is even worse than we thought. The decline may give impacts to the environment by having droughts, to the livelihood of the farmers who are largely dependent on water, and even to the public health which can lead to numerous illnesses and diseases. Even though the extremes are increasing, the study is very beneficial in managing and using the water resources, planning the alternative move when the situation got worse, to predict the next possible year of intense rainfall, and the study is also concerned about how to save water in times of excess and those times when water resource is too little.

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