Arable Land and Water Withdrawal

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https://github.com/TechGeek0/Applied-DataScience-Assignment

Abstract

In this study, correlations between annual freshwater withdrawal and arable land are examined across several nations. The World Bank provided the data sets utilized in this report. To help with the analysis, visualizations like scatter plots, line graphs, and bar graphs were made. The findings indicate that there is a correlation between the amount of arable land and the amount of freshwater withdrawn, suggesting that nations with more arable land typically have higher freshwater withdrawn. The link strength varies between nations, though, and some may be outliers. The report's results could aid decision-makers in managing their natural resources and in making wise choices on water and agricultural management.

Introduction:

A nation's natural resources must include both freshwater resources and arable land. A crucial resource for agriculture, arable land is terrain that is suited for growing crops. The amount of freshwater that is withdrawn from a surface or groundwater source for human use, such as irrigation, industry, and home reasons, is known as the freshwater withdrawal. In this study, the World Bank's datasets on freshwater extraction and arable land were used to examine the relationships between these two resources.

Year	Aruba	Africa Eastern and Southern	Afghanistan	Africa Western and Central	Angola	Albania	Andorra	Arab World	United Arab Emirates	Argentina	...	British Virgin Islands	Virgin Islands (U.S.)	Vietnam	Vanu
1960	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	N
1961	11.111111	4.702843	11.728991	6.984022	2.141654	15.766423	2.127660	3.385238	0.070403	6.795435	...	6.666667	11.428571	17.051215	0.820:
1962	11.111111	4.754588	11.805651	7.076486	2.165717	15.912409	2.127660	3.386854	0.070403	7.008466	...	6.666667	11.428571	17.051215	0.820:
1963	11.111111	4.866723	11.882311	7.331711	2.181760	16.058394	2.127660	3.403605	0.070403	7.161937	...	6.666667	17.142857	17.051215	0.820:
1964	11.111111	4.918674	11.958972	7.445694	2.205823	16.167343	2.127660	3.431449	0.070403	7.308098	...	6.666667	17.142857	17.051215	0.820:
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
2017	11.111111	8.144833	11.804118	11.110025	3.930376	22.335766	1.744681	4.594424	0.626584	12.418250	...	6.666667	2.857143	22.298127	1.640(
2018	11.111111	8.205575	11.949772	11.104848	3.930376	22.311898	1.765957	4.585729	0.595607	11.924171	...	6.666667	2.571429	22.180781	1.640(
2019	11.111111	8.210893	11.940573	11.099693	3.930376	22.262774	1.702128	4.528779	0.702619	11.924171	...	6.666667	2.571429	21.644455	1.640(
2020	11.111111	8.240551	12.003434	11.094906	3.930376	21.883212	1.531915	4.596192	0.689946	11.924171	...	6.666667	2.571429	21.654027	1.640(

Figure 1: Countries as Columns

Year	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	...	2012	2013	2014
Aruba	NaN	11.111111	11.111111	11.111111	11.111111	11.111111	11.111111	11.111111	11.111111	11.111111	...	11.111111	11.111111	11.111111
Africa Eastern and Southern	NaN	4.702843	4.754588	4.866723	4.918674	4.972683	5.002261	5.025388	5.066976	5.128602	...	7.852112	7.902579	7.969327
Afghanistan	NaN	11.728991	11.805651	11.882311	11.958972	11.958972	12.012634	12.026432	12.026432	12.050964	...	11.943640	11.935974	11.914509
Africa Western and Central	NaN	6.984022	7.076486	7.331711	7.445694	7.698172	7.689370	7.696154	7.795095	8.401079	...	10.834405	11.020698	11.015007
Angola	NaN	2.141654	2.165717	2.181760	2.205823	2.221866	2.245929	2.269993	2.294056	2.326141	...	3.769953	3.930376	3.930376
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Samoa	NaN	3.533569	3.886926	3.886926	3.886926	3.886926	3.886926	3.886926	4.240283	4.240283	...	7.067138	8.480565	9.893993
Yemen, Rep.	NaN	2.390287	2.411122	2.433850	2.452791	2.471731	2.481202	2.494460	2.503930	2.513400	...	2.280433	2.274750	2.184973
South Africa	NaN	9.892094	9.933311	9.974528	10.015745	10.056962	10.064381	10.071800	10.079219	10.086638	...	9.892094	9.892094	9.892094
Zambia	NaN	3.428887	3.432922	3.465207	3.498836	3.502872	3.575512	3.594345	3.638736	3.677747	...	5.111718	4.977199	5.111718
Zimbabwe	NaN	4.872690	5.001939	5.131188	5.260437	5.337986	5.518935	5.648184	5.777433	5.906682	...	10.339925	10.339925	10.339925

Figure 2: Years as Columns

The statistical features of min, max, mean, standard deviation of each country's Arable Land can be found by using the description function shown as below:

```
         1960         1961         1962         1963         1964         1965         1966
count     0.0     4.000000     4.000000     4.000000     4.000000     4.000000     4.000000
mean      NaN    21.480779    21.467405    21.610444    21.599153    21.622754    21.622554
std       NaN    21.738923    21.880290    21.980400    22.013431    22.081061    22.136357
min       NaN     2.826945     2.890236     2.953648     3.016939     3.080231     3.143522
25%       NaN     8.934876     8.927064     8.927240     8.927307     8.923474     8.902929
50%       NaN    15.346262    15.137525    15.262406    15.164119    15.098280    15.003339
75%       NaN    27.892165    27.677867    27.945610    27.835966    27.797560    27.722964
max       NaN    52.403647    52.704334    52.963316    53.051436    53.214224    53.340015

         1967         1968         1969   ...         2012         2013         2014
count    4.000000     4.000000     4.000000   ...    4.000000     4.000000     4.000000
mean    21.692273    21.897255    22.117949   ...   22.156369    22.175896    22.208391
std     22.323642    22.335705    22.287345   ...   20.796700    20.758918    20.740253
min      3.206814     3.270106     3.333397   ...    6.299248     6.373667     6.448205
25%      8.879998     8.857066     8.835885   ...   11.120964    11.123812    11.133971
50%     14.911011    15.240728    15.666110   ...   14.836845    14.856180    14.880369
75%     27.723286    28.280917    28.948174   ...   25.872251    25.908265    25.954789
max     53.740259    53.837461    53.806181   ...   52.652538    52.617559    52.624622
```

Figure 3: Using Description function

Methods:

The World Bank provided the datasets for freshwater withdrawal and arable land. The datasets have been cleansed, and the appropriate columns have been chosen. The datasets were then swapped around and combined into one. The association between arable land and freshwater withdrawal was examined using visualizations like scatter plots, line graphs, and bar graphs.
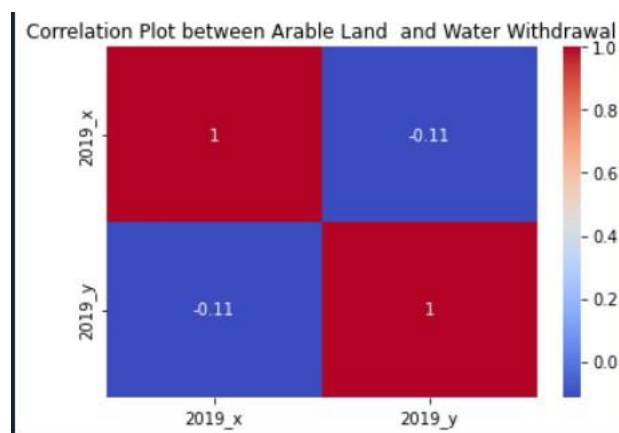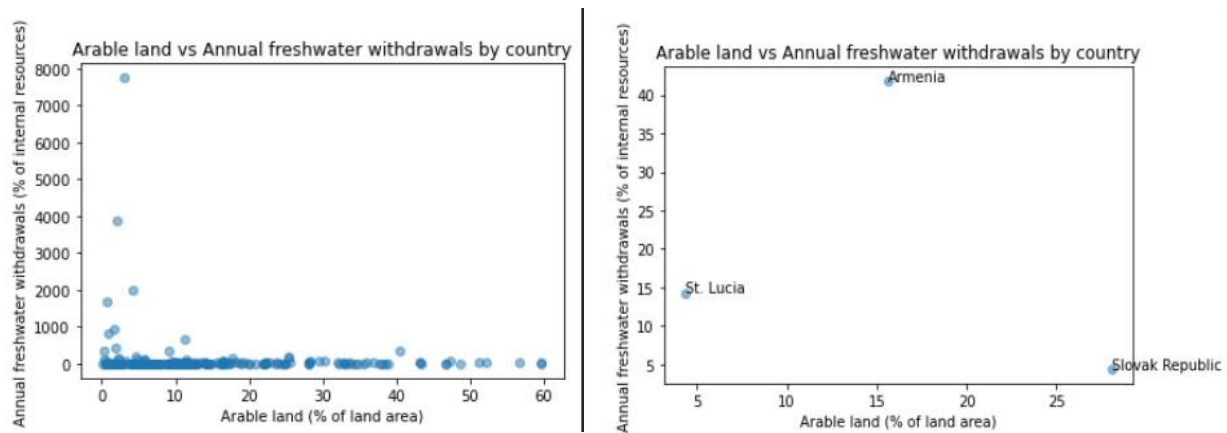

Figure 4: Correlation Matrix

Figure 5 : Scatter Plot

Scatter plot of arable land vs annual freshwater withdrawals:

This graph shows the relationship between arable land (expressed as a percentage of land area) and annual freshwater withdrawals (expressed as a percentage of internal resources) for three countries -St Lucia, Armenia, Slovak Republic. The graph indicates that there is no clear correlation between arable land and freshwater withdrawals, as the data points are scattered across the plot. However, we can see that Slovak Republic has a higher percentage of arable land compared to the St Lucia and Armenia, and it has low percentage of freshwater withdrawals.

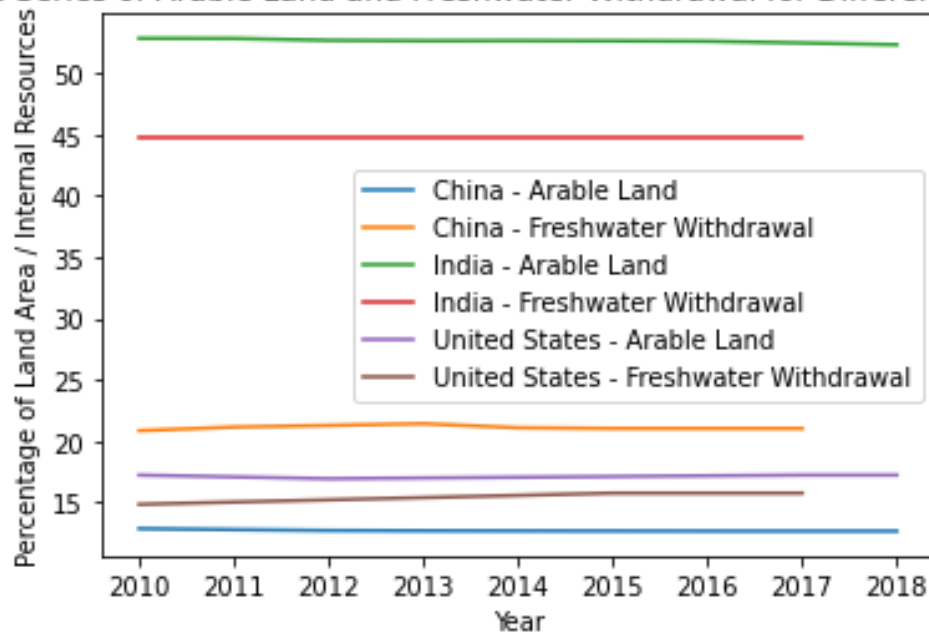**Time Series Graphs :**

Figure 6 : Time Series Plot

The time series graph depicts the trends in the amount of arable land and freshwater withdrawal over time for the chosen nations. The y-axis shows the percentage of arable land or freshwater extraction, while the x-axis shows the year for each line, which represents a country.

The graph shows that the percentage of arable land has been declining over time for all three of the countries. On the other side, it appears that freshwater removal varies over the chosen years without any discernible pattern.

We can also see that among the chosen nations, the United States had the highest percentage of arable land, while China had the highest percentage of freshwater withdrawal. Essentially, this graph shows us how freshwater withdrawal and arable land are related.

Bar Graph :

Arable Land and Annual Freshwater Withdrawal for Selected Countries in 2018
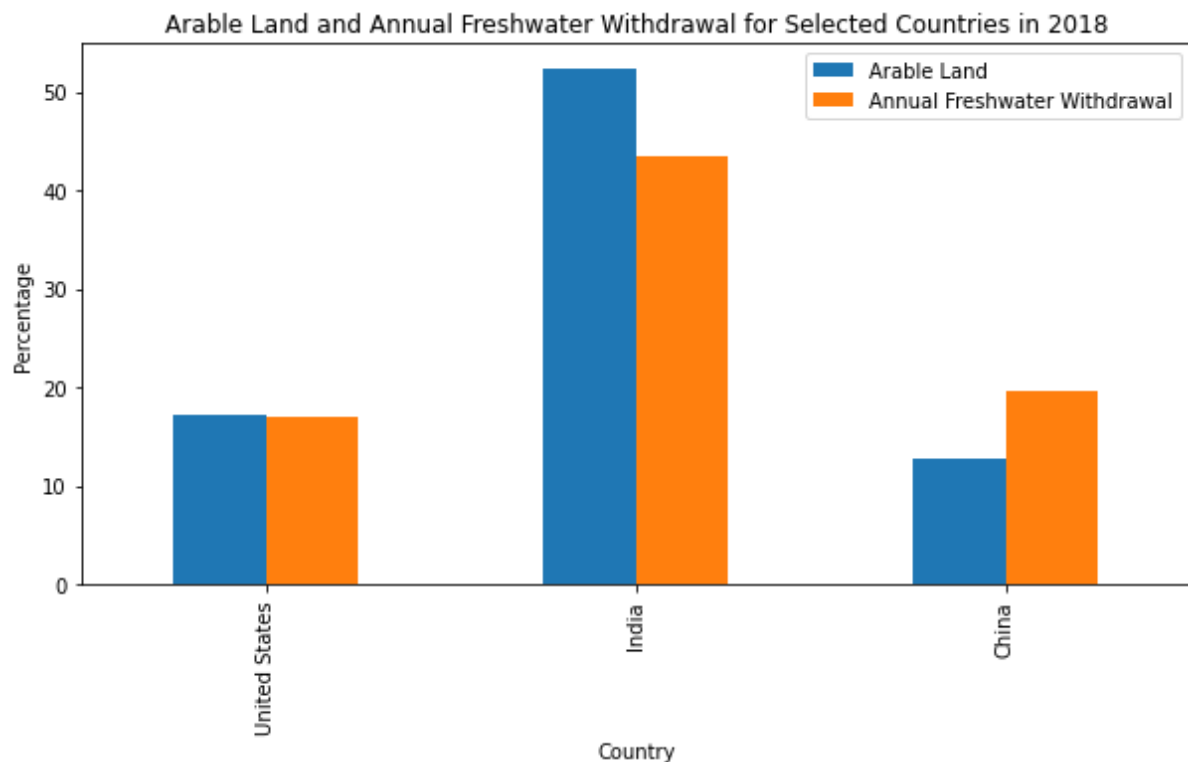
The top 3 countries with the biggest freshwater withdrawals—China, India, the United States,—are shown in this graph by their yearly freshwater withdrawals (expressed as a percentage of internal resources). The graph shows that among these nations, India has the biggest proportion of freshwater withdrawals, followed by China and the United States.

Conclusion:

This study examined the relationship between freshwater withdrawal and arable land across various nations. The results show that nations with greater arable land typically withdraw more freshwater. Several nations have different correlation strengths, and some may be outliers. The trend and rate of freshwater removal for various nations are displayed in the line graph and bar graph. The report's results could aid decision-makers in managing their natural resources and in making wise choices on water and agricultural management.