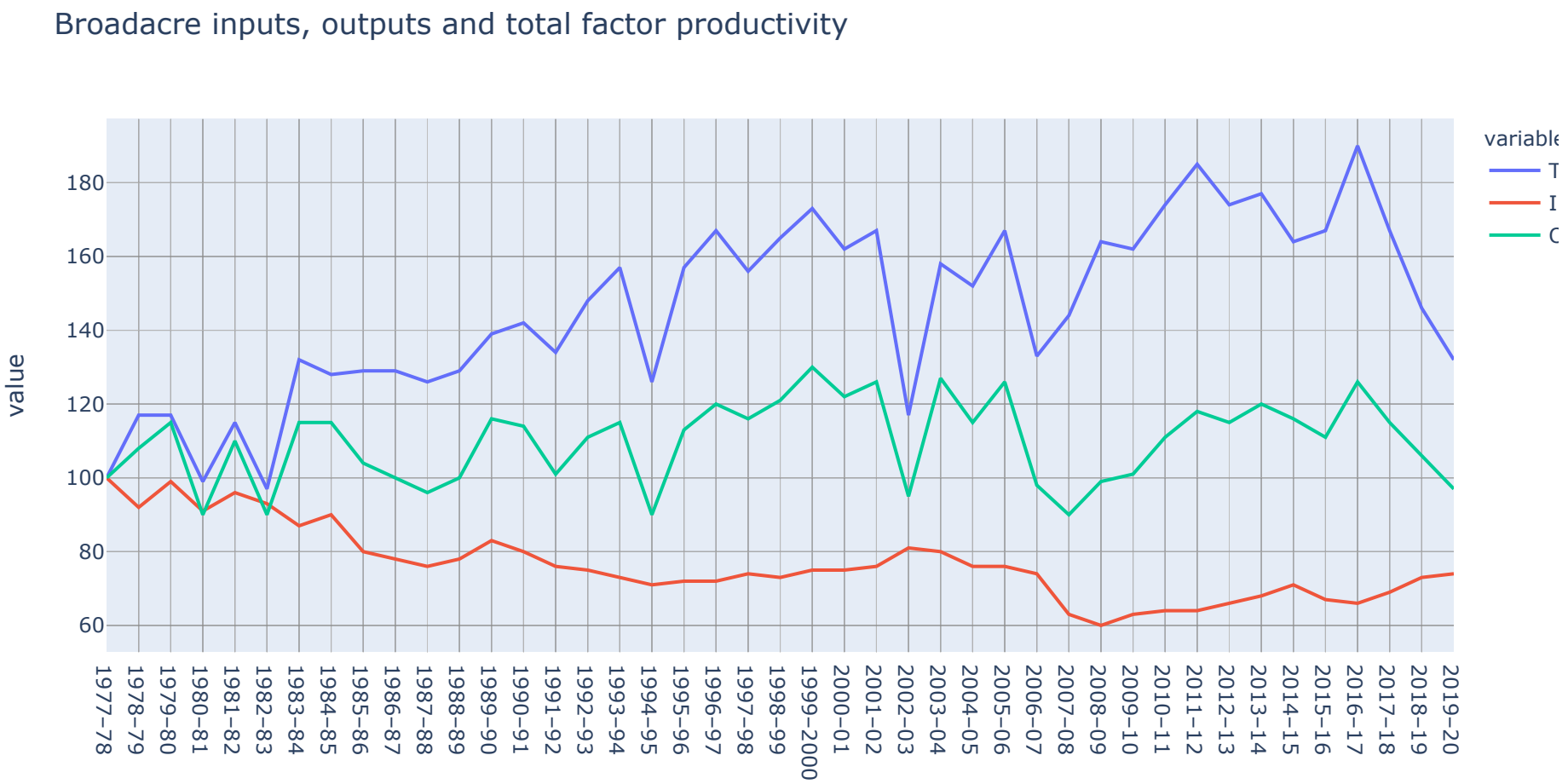
In [1]:
```
import math
import pandas as pd
import plotly.express as px
import matplotlib.pyplot as plt
import plotly.graph_objects as go
```

How have droughts affected Broadacre industry in Australia?

In [2]:
```
broadacre = pd.read_csv('broadacre.csv')
broadacre
```

24	2001–02	76	126	167
25	2002–03	81	95	117
26	2003–04	80	127	158
27	2004–05	76	115	152
28	2005–06	76	126	167
29	2006–07	74	98	133
30	2007–08	63	90	144
31	2008–09	60	99	164
32	2009–10	63	101	162
33	2010–11	64	111	174
34	2011–12	64	118	185
35	2012–13	66	115	174
36	2013–14	68	120	177

In [3]:
```
x.line(broadacre, x="Year", y=["TFP","Input","Output"],title='Broadacre inputs, outputs and total factor producti
w()
```



Australia's agriculture sector faces number of pressures, including climate variability, deciling terms of trade and increased international competition(ABARES). The sector is highly export oriented with two-thirds of agricultural production exported (ABARES). Therefore, remaining profitable and sustainable is an increasing challenge for Australian farmers (ABARES)

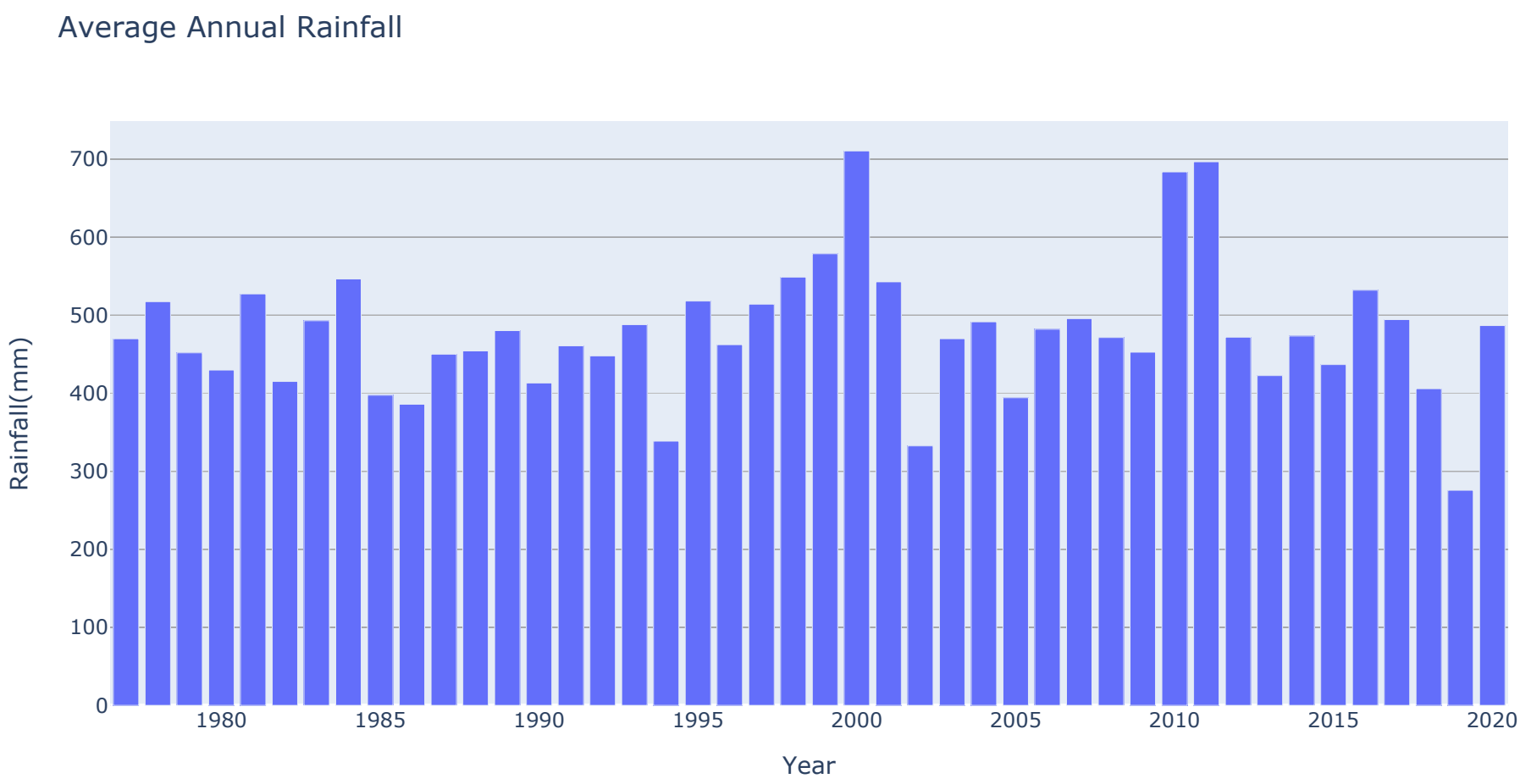
Broadacre productivity growth slowed between 1998–99 and 2004–05, in part due to drought during the 2000s. Productivity returned to growth between 2005–06 and 2011–12 before slowing down again in recent years. The slowdown in growth appears to have can be attributed to seasonal conditions, with significant downturns in drought years.

In [4]:
```
rainfall = pd.read_csv('annual_rainfall.csv')
rainfall
```

Out[4]:

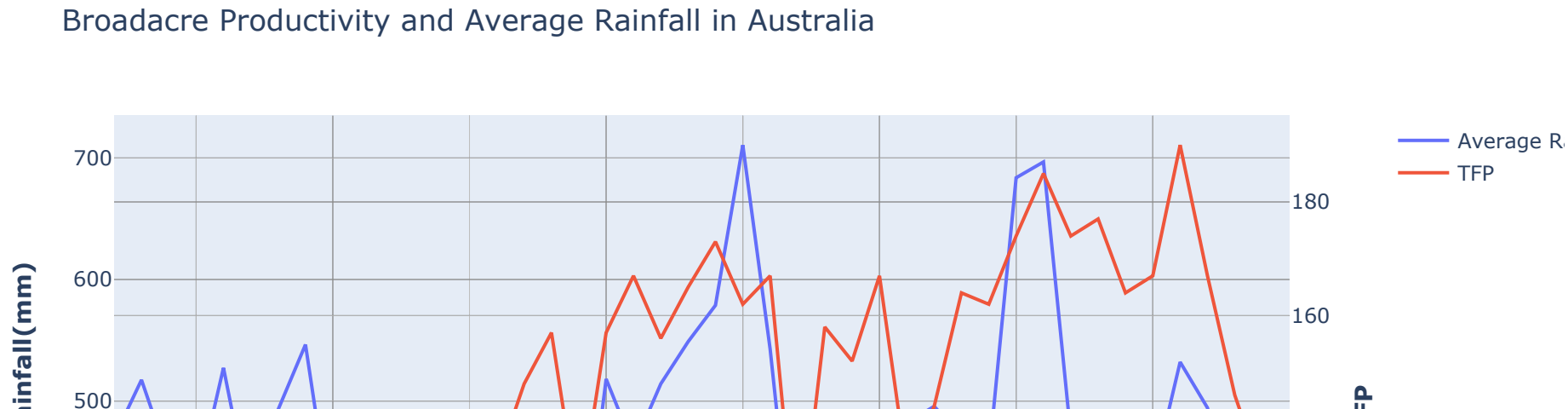
	Year	Rainfall(mm)	TFP
0	1977	469.86	100.0
1	1978	517.39	117.0
2	1979	451.81	117.0
3	1980	429.75	99.0
4	1981	527.34	115.0
5	1982	415.14	97.0
6	1983	492.99	132.0
7	1984	546.45	128.0
8	1985	397.53	129.0
9	1986	385.94	129.0
10	1987	450.08	126.0

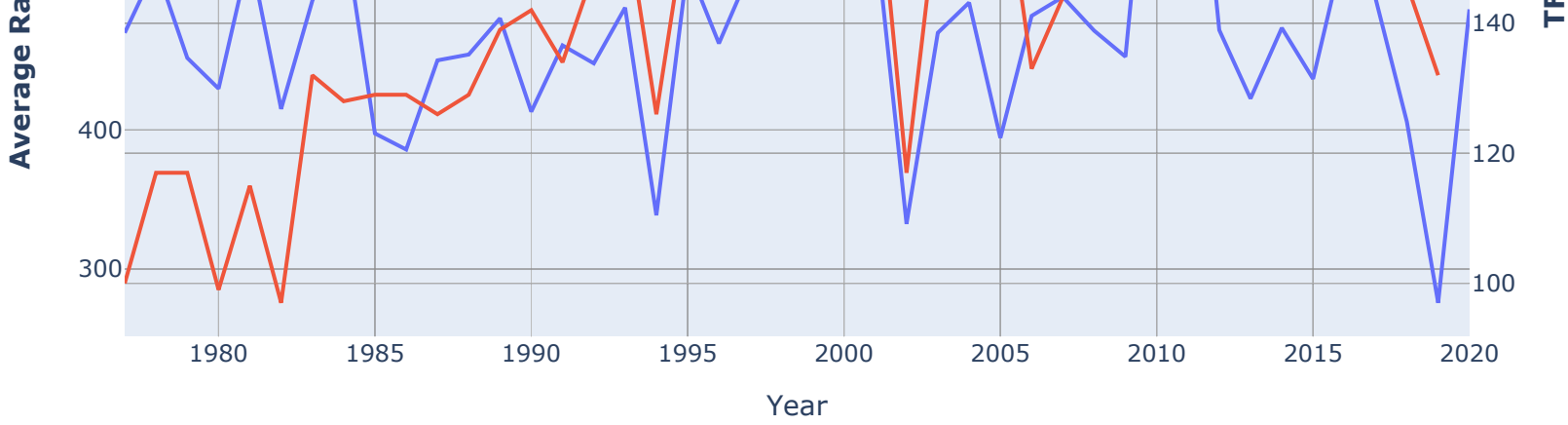
In [5]:
```
import plotly.express as px
fig = px.bar(rainfall, x='Year', y='Rainfall(mm)', title='Average Annual Rainfall')
fig.show()
```



Agricultural productivity volatility is often caused by water availability, especially when drought causes water to be a limiting factor to production. In this project, the water availability will be analyzed by utilizing the average annual rainfall. The average rainfall was noticeably low in 1994, 2002. 2005 and 2019. In fact, the average annual rainfall in 2019 was in significant drought as it had the lowest precipitation level since 1978

In [6]:
```
import plotly.graph_objects as go
from plotly.subplots import make_subplots

# Create figure with secondary y-axis
fig = make_subplots(specs=[[{"secondary_y": True}]])

# Add traces
fig.add_trace(
    go.Scatter(x=rainfall['Year'], y=rainfall['Rainfall(mm)'], name="Average Rainfall"),
    secondary_y=False,
)

fig.add_trace(
    go.Scatter(x=rainfall.Year, y=rainfall.TFP, name="TFP"),
    secondary_y=True,
)

# Add figure title
fig.update_layout(
    title_text="Broadacre Productivity and Average Rainfall in Australia"
)

# Set x-axis title
fig.update_xaxes(title_text="Year")

# Set y-axes titles
fig.update_yaxes(title_text="<b>Average Rainfall(mm)</b>", secondary_y=False)
fig.update_yaxes(title_text="<b>TFP</b>", secondary_y=True)

fig.show()
```





The effect of average annual rainfall on Australian broadacre TFP is evident in this chart, which demonstrates that when water is a limiting factor to production—such as during a prolonged drought-- the effect is reflected in Total Factor Productivity (ABARES). For example, productivity fell between 2017- 2020 because the average annual rainfall was decreasing during these years. This means that when drought causes water to be a limiting factor to production, the measured quantity of inputs generally falls, some cases, by less than the quantity of outputs, and so TFP falls (ABARES)