Land Use and Land Cover

LULC Analysis

1- Land Use and Land Cover:

The terms land use and land cover are often used interchangeably, but each term has its own unique meaning. Land cover refers to the surface cover on the ground like vegetation, urban infrastructure, water, bare soil etc. Identification of land cover establishes the baseline information for activities like thematic mapping and change detection analysis. Land use refers to the purpose the land serves, for example, recreation, wildlife habitat, or agriculture.

1.1- Importance

- LULC maps play a significant and prime role in planning, management and monitoring programmes at local, regional and national levels.
- LULC maps also help us to study the changes that are happening in our ecosystem and environment.
- Wildlife habitat protection and many more

In [ ]:
```
pip install plotly
```

```
Requirement already satisfied: plotly in c:\anaconda\lib\site-packages (5.5.0)
Requirement already satisfied: six in c:\anaconda\lib\site-packages (from plotly) (1.16.0)
Requirement already satisfied: tenacity>=6.2.0 in c:\anaconda\lib\site-packages (from plotly) (8.0.1)
Note: you may need to restart the kernel to use updated packages.
```

In [ ]:
```
#import libraries
import seaborn as sns
#canvas style
sns.set(style='whitegrid')
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [ ]:
```
##importing dataset
## Importing LU information of 5 countries
LUG=pd.read_csv("FAOSTAT_forest_1-13-2022.csv")
LUG.head()
```

Out[ ]:

	Domain Code	Domain	Area Code	Area	Element Code	Element	Item Code	Item	Year Code	Year	Source Code	Source	Unit	Value	Flag	Flag Description	Note
0	GF	Forests	165	Pakistan	5110	Area	6751	Forestland	1990	1990	3050	FAO TIER 1	1000 ha	4986.7900	E	Expert sources from FAO (including other divis...	NaN
1	GF	Forests	165	Pakistan	72332	Net emissions/removals (CO2) (Forest land)	6751	Forestland	1990	1990	3050	FAO TIER 1	kilotonnes	0.0000	Fc	Calculated data	NaN
2	GF	Forests	351	China	5110	Area	6751	Forestland	1990	1990	3050	FAO TIER 1	1000 ha	157140.5900	A	Aggregate, may include official, semi-official...	NaN
3	GF	Forests	351	China	72332	Net emissions/removals (CO2) (Forest land)	6751	Forestland	1990	1990	3050	FAO TIER 1	kilotonnes	-350983.5047	A	Aggregate, may include official, semi-official...	NaN
4	GF	Forests	351	China	72332	Net emissions/removals (CO2) (Forest land)	6751	Forestland	1991	1991	3050	FAO TIER 1	kilotonnes	-350983.5047	A	Aggregate, may include official, semi-official...	NaN

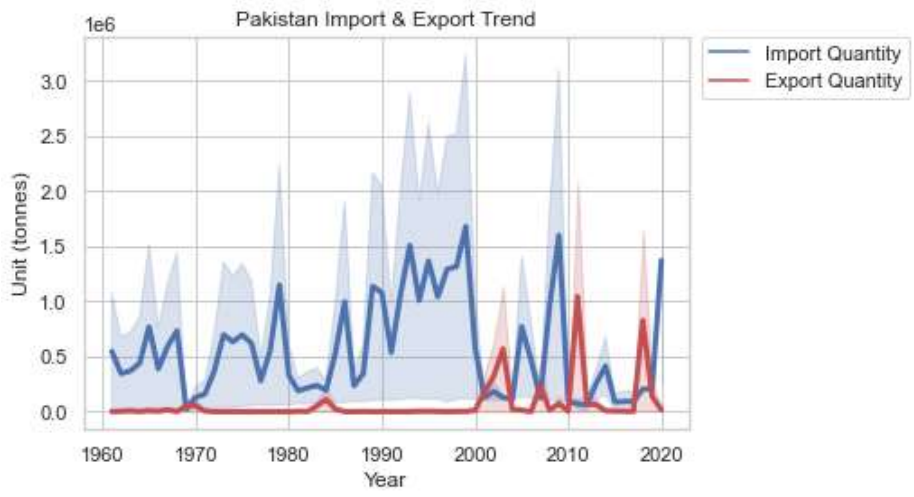
In [ ]:
```
##importing dataset
## Importing LU information of 5 countries
LU=pd.read_csv("FAO_ALL_LU.csv")
#LU.head()
```

In [ ]:
```
IE=pd.read_csv("FAOSTAT_import_1-13-2022.csv")
IE.head()
```

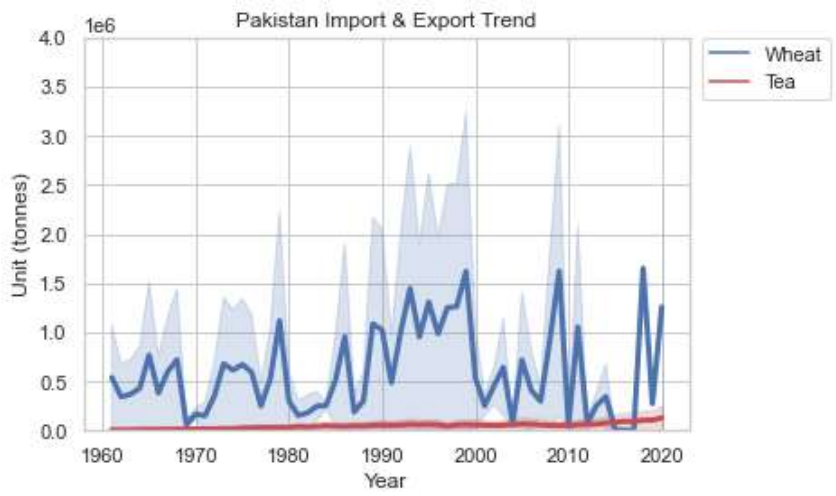
Out[ ]:

	Domain Code	Domain	Area Code	Area	Element Code	Element	Item Code	Item	Year Code	Year	Unit	Value	Flag	Flag Description
0	TCL	Crops and livestock products	165	Pakistan	5610	Import Quantity	15	Wheat	1961	1961	tonnes	1078899	NaN	Official data
1	TCL	Crops and livestock products	165	Pakistan	5910	Export Quantity	15	Wheat	1961	1961	tonnes	432	NaN	Official data
2	TCL	Crops and livestock products	165	Pakistan	5610	Import Quantity	667	Tea	1961	1961	tonnes	16056	NaN	Official data
3	TCL	Crops and livestock products	165	Pakistan	5910	Export Quantity	667	Tea	1961	1961	tonnes	0	NaN	Official data
4	TCL	Crops and livestock products	165	Pakistan	5610	Import Quantity	15	Wheat	1962	1962	tonnes	677219	NaN	Official data

In [ ]:
```
sns.lineplot(data=IE, x="Year", y="Value", hue="Element", linewidth=3,
             palette={"Import Quantity": "b", "Export Quantity": "r"}
              ).set(title='Pakistan Import & Export Trend')
plt.xlabel("Year")
plt.ylabel("Unit (tonnes)")
plt.legend(bbox_to_anchor=(1.02, 1), loc='upper left', borderaxespad=0)
plt.show()
```

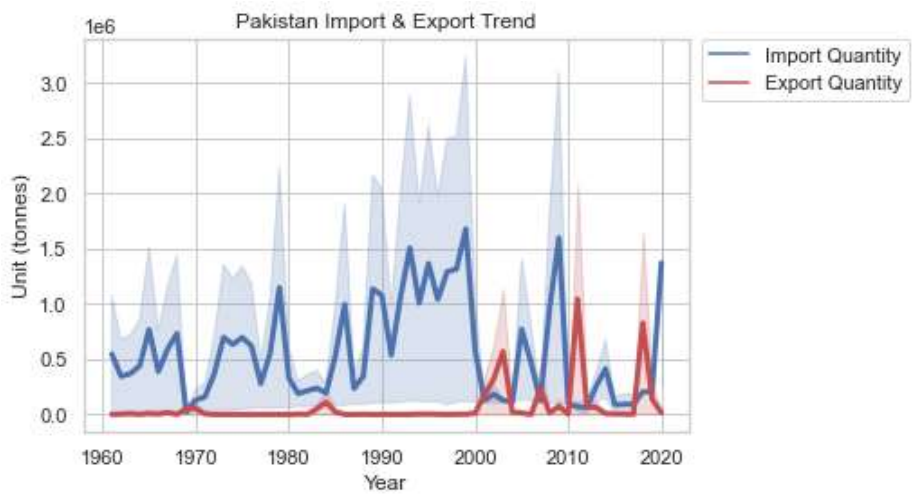


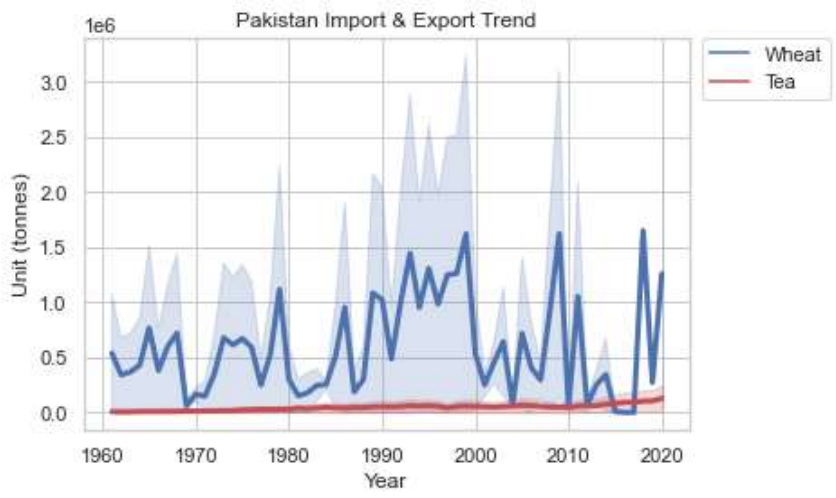
In [ ]:
```
sns.lineplot(data=IE, x="Year", y="Value", hue="Item", linewidth=3,
             palette={"Wheat": "b", "Tea": "r"}
              ).set(title='Pakistan Import & Export Trend')
plt.xlabel("Year")
plt.ylabel("Unit (tonnes)")
plt.ylim(0, 4000000)
plt.legend(bbox_to_anchor=(1.02, 1), loc='upper left', borderaxespad=0)
plt.show()
```



In [ ]:
```
sns.lineplot(data=IE, x="Year", y="Value", hue="Element", linewidth=3,
             palette={"Import Quantity": "b", "Export Quantity": "r"}
              ).set(title='Pakistan Import & Export Trend')
plt.xlabel("Year")
plt.ylabel("Unit (tonnes)")
plt.legend(bbox_to_anchor=(1.02, 1), loc='upper left', borderaxespad=0)
fig, axs = plt.subplots(ncols=1)

sns.lineplot(data=IE, x="Year", y="Value", hue="Item", linewidth=3,
             palette={"Wheat": "b", "Tea": "r"}
              ).set(title='Pakistan Import & Export Trend')
plt.xlabel("Year")
plt.ylabel("Unit (tonnes)")
plt.legend(bbox_to_anchor=(1.02, 1), loc='upper left', borderaxespad=0)
plt.show()
```

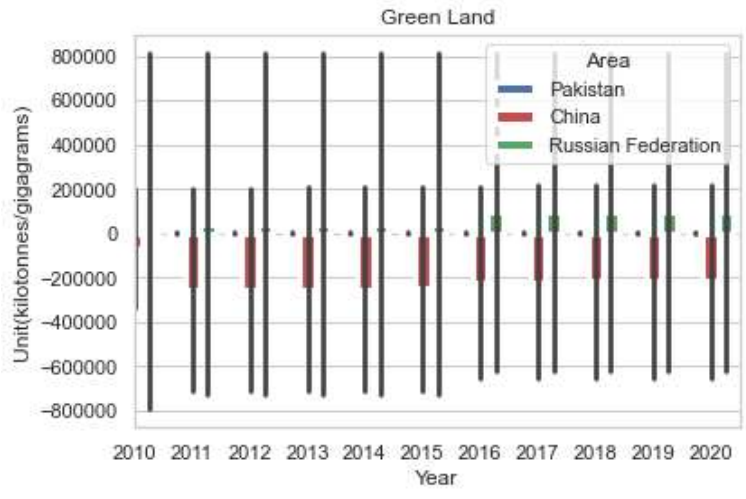




In [ ]:

```
sns.barplot(data=LUG, x="Year", y="Value",saturation=1, hue="Area",
            linewidth=3,
            palette={"Pakistan": "b", "China": "r","Russian Federation":"g"}
             ).set(title='Green Land')

plt.xlabel("Year")
plt.ylabel("Unit(kilotonnes/gigagrams)")
plt.xlim(20)
plt.show()
```



Pandas Library practice

In [ ]:

```
##importing dataset
## Importing LU information of 5 countries
LU=pd.read_csv("FAO_LU_comparison.csv")
#LU.head()
```

In [ ]:

```
LUW=pd.read_csv("FAOSTAT_wastewater_1-13-2022.csv")
LUW.head()
```

Out[ ]:

	Domain Code	Domain	Area Code	Area	Element Code	Element	Item Code	Item	Year Code	Year	Unit	Value	Flag	Flag Description
0	GW	Waste Disposal	165	Pakistan	7225	Emissions (CH4)	6989	Industrial wastewater	1990	1990	kilotonnes	30.170089	Fc	Calculated data
1	GW	Waste Disposal	165	Pakistan	723112	Emissions (CO2eq) (SAR)	6989	Industrial wastewater	1990	1990	gigagrams	771.065186	Fc	Calculated data
2	GW	Waste Disposal	165	Pakistan	723114	Emissions (CO2eq) (AR4)	6989	Industrial wastewater	1990	1990	gigagrams	886.423221	Fc	Calculated data
3	GW	Waste Disposal	351	China	7225	Emissions (CH4)	6989	Industrial wastewater	1990	1990	kilotonnes	272.908754	A	Aggregate, may include official, semi-official...
4	GW	Waste Disposal	351	China	723112	Emissions (CO2eq) (SAR)	6989	Industrial wastewater	1990	1990	gigagrams	6687.476069	A	Aggregate, may include official, semi-official...

In [ ]:

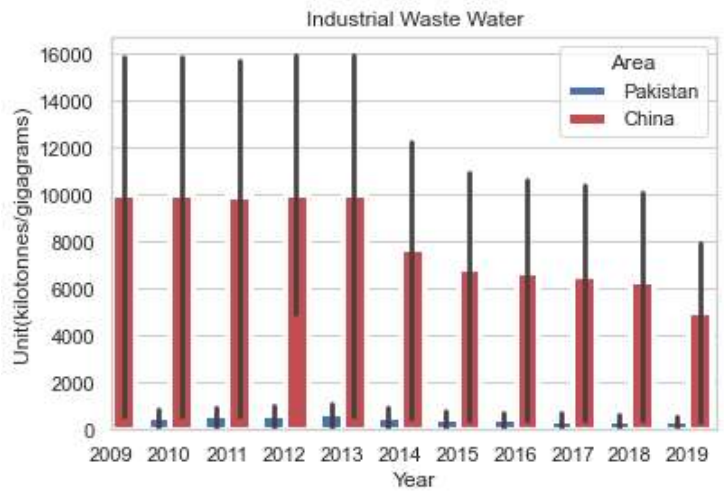
```
import plotly.express as px
#df = px.data.tips()
fig = px.histogram(LUW, x="Year", y="Value", color="Area",
                   title="Industrial Waste_Water")
fig.show()
```

Image

In [ ]:

```
sns.barplot(data=LUW, x="Year", y="Value",saturation=1, hue="Area",
            linewidth=3,
            palette={"Pakistan": "b", "China": "r"}
             ).set(title='Industrial Waste Water')

plt.xlabel("Year")
plt.ylabel("Unit(kilotonnes/gigagrams)")
plt.xlim(19)
plt.show()
```

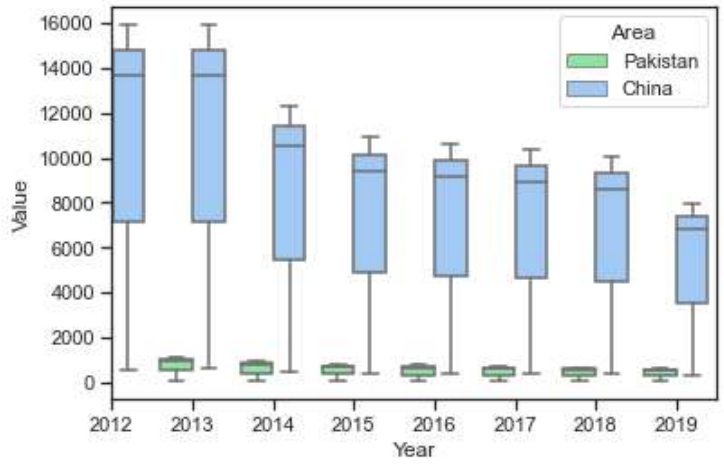


In [ ]:
```
import seaborn as sns
sns.set_theme(style="ticks", palette="pastel")

# Load the example tips datase

# Draw a nested boxplot to show bills by day and time
sns.boxplot(x="Year", y="Value",
            hue="Area", palette=["g","b"],saturation=1,
            data=LUW)
#sns.despine(offset=20, trim=True)
plt.xlim(22)
```

Out[ ]: (22.0, 29.5)



In [ ]:
```
##importing dataset
# Pakistan LC data
LC=pd.read_csv("LC.csv")
#LC
```

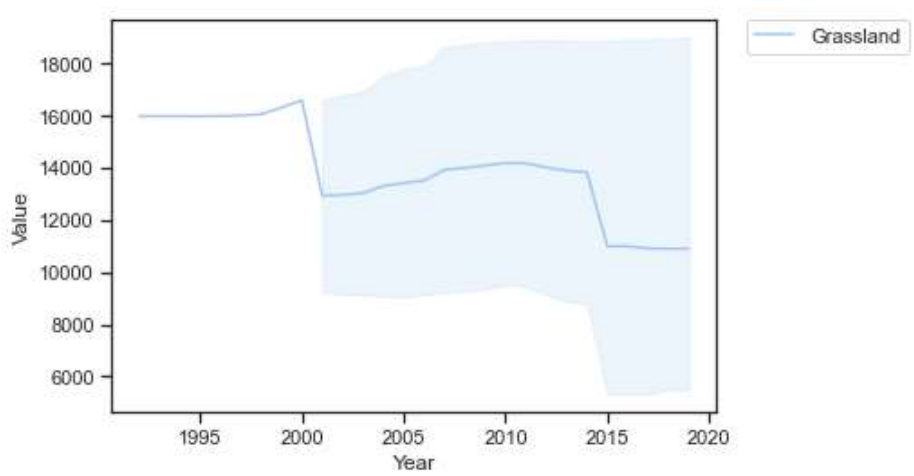
In [ ]:
```
##importing grassland dataset of Pakistan
LG=pd.read_csv("Grassland_Pak.csv")
#LG.head()
```

Grassland of Pakistan area is getting decrease with the time

Timeseries map of grassland

In [ ]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#plot multiple time series
sns.lineplot(x='Year', y='Value', hue='Item', data=LG)
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left', borderaxespad=0)
plt.show()
```



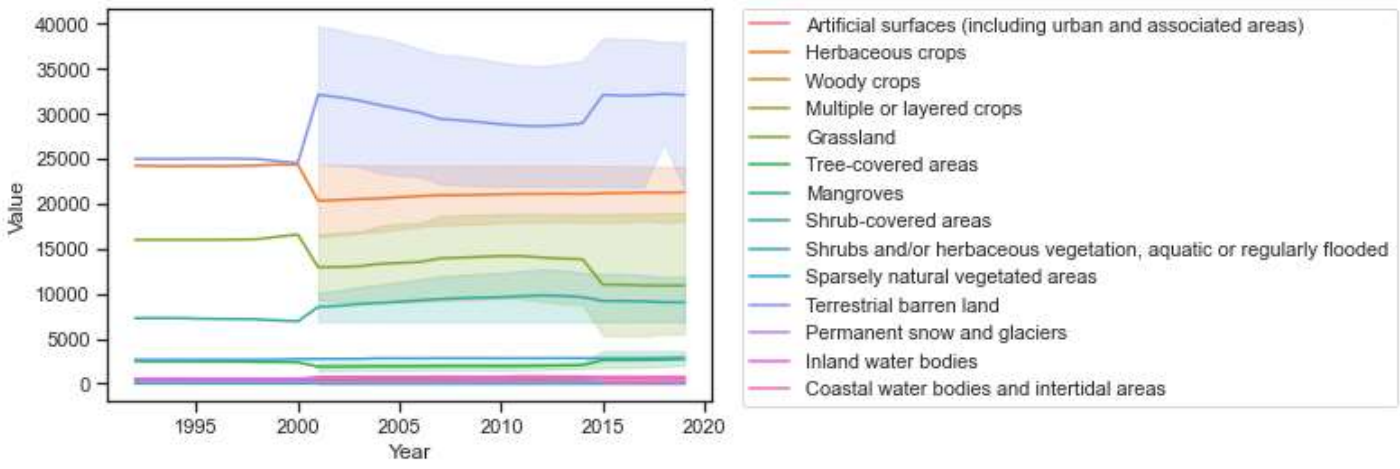
In [ ]:
```
##importing grassland dataset
LUA=pd.read_csv("FAO_ALL_LU.csv")
#LUA.head()
```

Land Use all calsses trend in Pakistan

* Time, types of classes and value analysis

In [ ]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#plot multiple time series
sns.lineplot(x='Year', y='Value', hue='Item', data=LUA)
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left', borderaxespad=0)
plt.show()
```



In [ ]:
```
import plotly.express as px #Some selected items
LC=pd.read_csv("LC.csv")
fig = px.histogram(LC, x="Item", y="Value", color="Area",
                   marginal="box", # or violin, rug
                   hover_data=LC.columns)
fig.show()
```

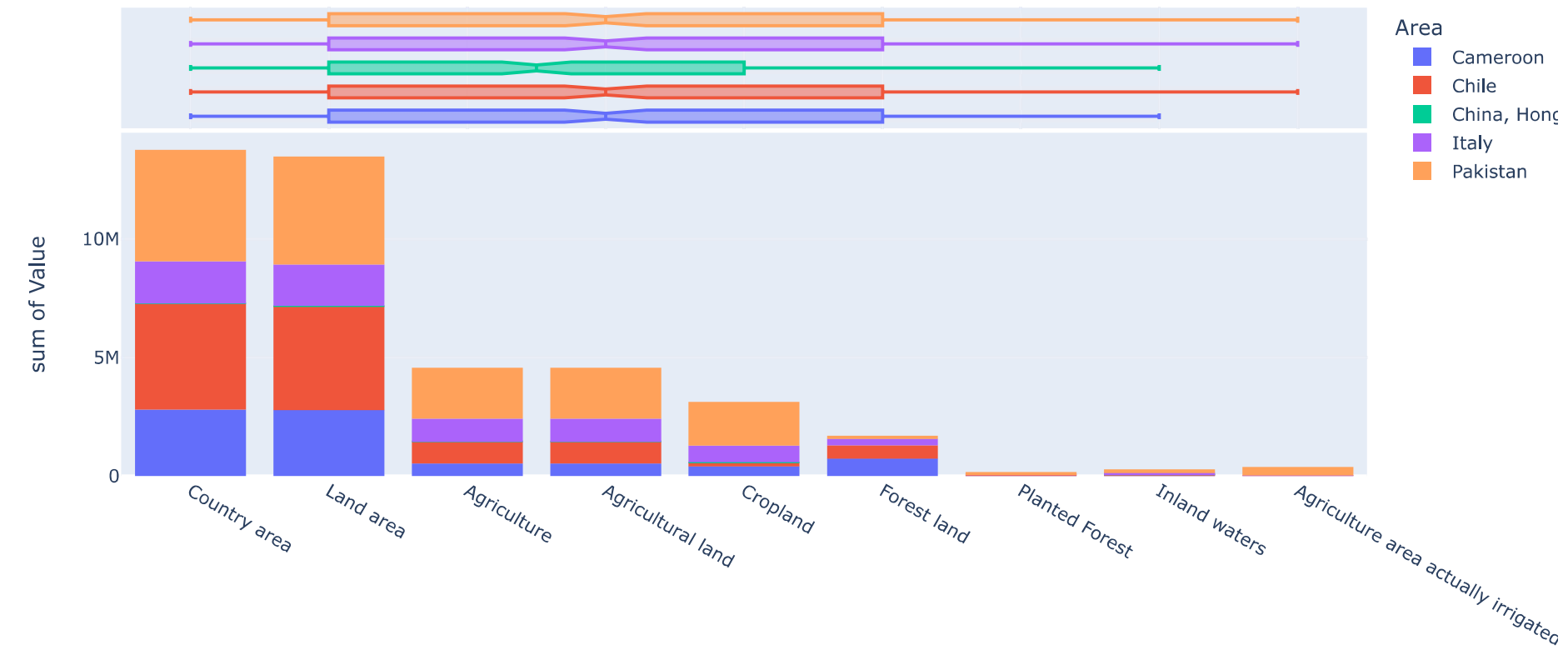
Compasrion with other countries

each country has specific value for every LU class

How to run plotly graph in VS code

In [ ]:
```
import plotly.io as pio
#pio.renderers.default = "vscode"
pio.renderers.default = "notebook_connected"
```

In [ ]:
```
import plotly.express as px
LU=pd.read_csv("FAO_LU_comparison.csv")
fig = px.histogram(LU, x="Item", y="Value", color="Area",
                   marginal="box", # or violin, rug
                   hover_data=LU.columns)
fig.show()
```

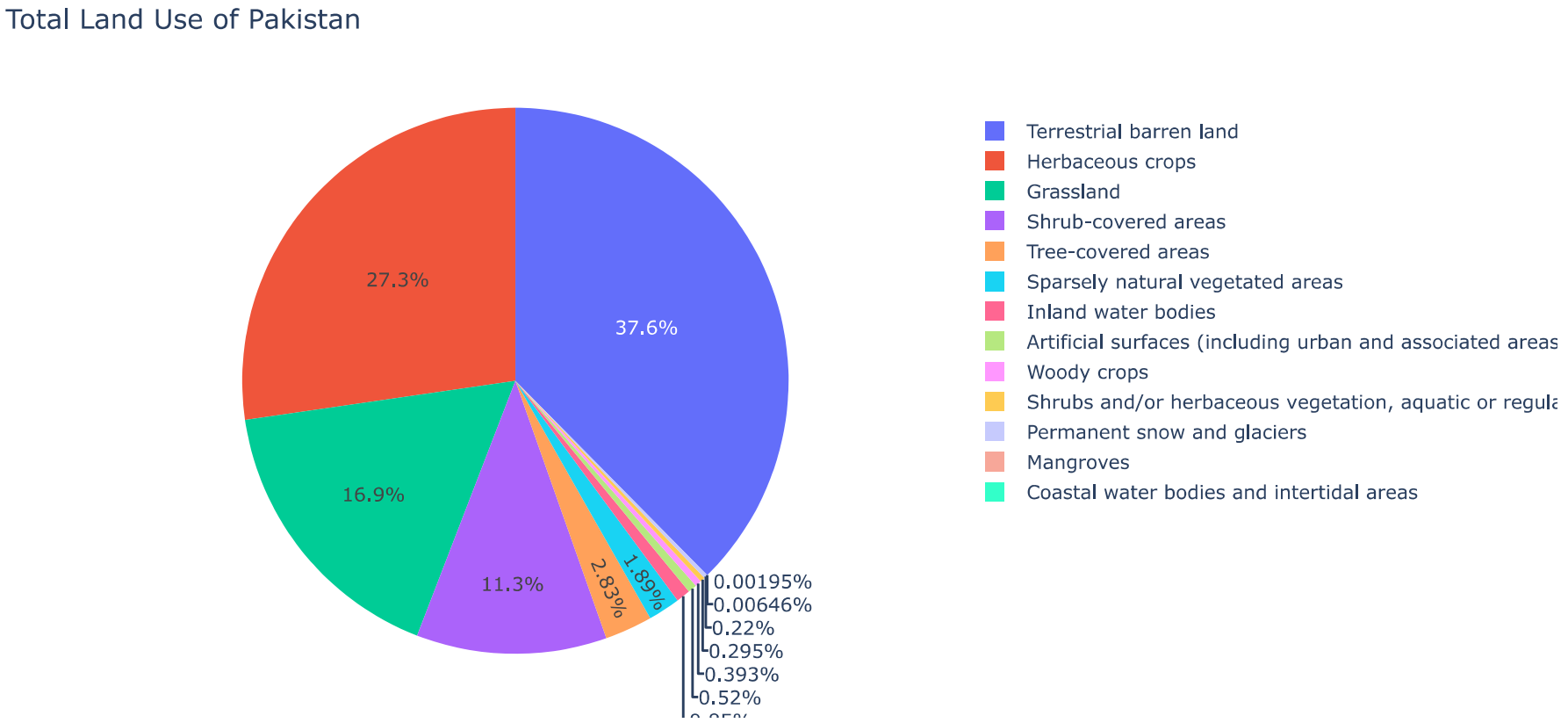


Image

Pie chart analysis for each Land use class

- High value for Terrestrial barren land
- Less for Mangroves, woody crops, inland water bodies etc

In [ ]:
```
import plotly.express as px
#df = px.data.gapminder().query("year == 2007").query("Area == 'Pakistan','Italy','Chile','Cameroon'")
#df.loc[df['Value'] < 2.e6, 'country'] = 'Other countries' # Represent only large countries
fig = px.pie(LUA, values='Value', names='Item', title='Total Land Use of Pakistan')
fig.show()
```

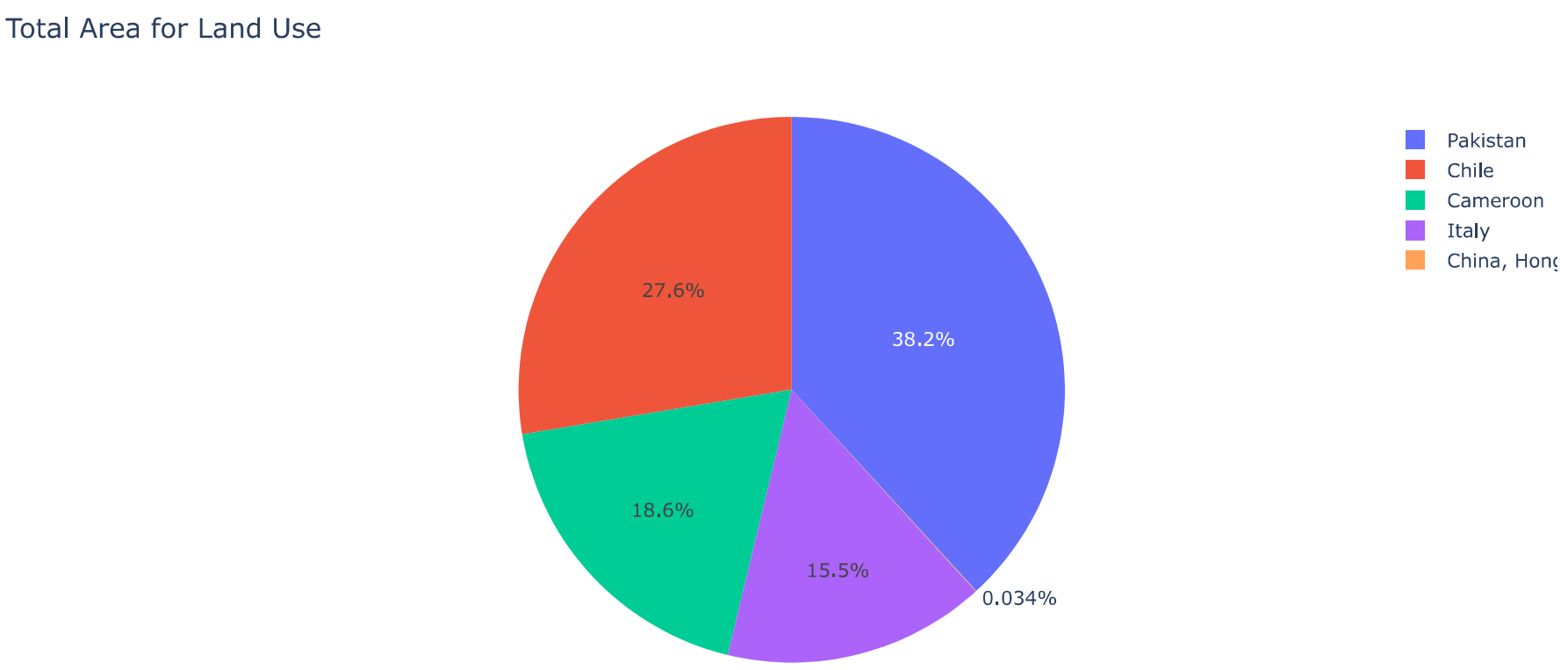


Image

Other contries Land use

- Pakistan and Chile have more value

In [ ]:
```
import plotly.express as px
#df = px.data.gapminder().query("year == 2007").query("Area == 'Pakistan','Italy','Chile','Cameroon'")
#df.loc[df['Value'] < 2.e6, 'country'] = 'Other countries' # Represent only large countries
fig = px.pie(LU, values='Value', names='Area', title='Total Area for Land Use')
fig.show()
```



Image

Some pandas practice on FAO data

In [ ]:
```
##importing dataset
LU=pd.read_csv("FAO_LU_comparison.csv")
#LU.head()
```

In [ ]:
```
mean1 = LU['Value'].mean() #mean function
mean1
```

Out[ ]:
```
19435.188111914635
```

In [ ]:
```
LU_PAK=LU[LU["Area"]=="Pakistan"]
#LU_PAK
```

In [ ]:
```
mean4 = LU_PAK['Value'].mean() #mean function
mean4
```

Out[ ]:
```
34583.710480561575
```

In [ ]:
```
LU_ITA=LU[LU["Area"]=="Italy"]
```

In [ ]:
```
mean2 = LU_ITA['Value'].mean() #mean function
mean2
```

Out[ ]:
```
14436.351932372472
```

In [ ]:
```
LU_Chile=LU[LU["Area"]=="Chile"]
```

In [ ]:
```
mean3 = LU_Chile['Value'].mean() #mean function
mean3
```

Out[ ]:
```
26012.186008539386
```

In [ ]:
```
LU_Ca=LU[LU["Area"]=="Cameroon"]
```

In [ ]:
```
mean5 = LU_Ca['Value'].mean() #mean function
mean5
```

Out[ ]:
```
17587.760381981974
```

In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
#create values for table
td=[
    ["Country", "Mean"],
    ["Pak", 34583.710480561575],
    ["Italy", 14436.351932372472],
    ["Chile", 26012.186008539386],
    ["Cameroon", 17587.760381981974]
]
td
#create table
#table = ax.table(cellText=table_data, loc='center')
```

Out[ ]:
```
[['Country', 'Mean'],
 ['Pak', 34583.710480561575],
 ['Italy', 14436.351932372472],
 ['Chile', 26012.186008539386],
 ['Cameroon', 17587.760381981974]]
```

In [ ]:
```
type(td)
```

Out[ ]:
```
list
```

In [ ]:
```
x=pd.DataFrame(td)
x
```

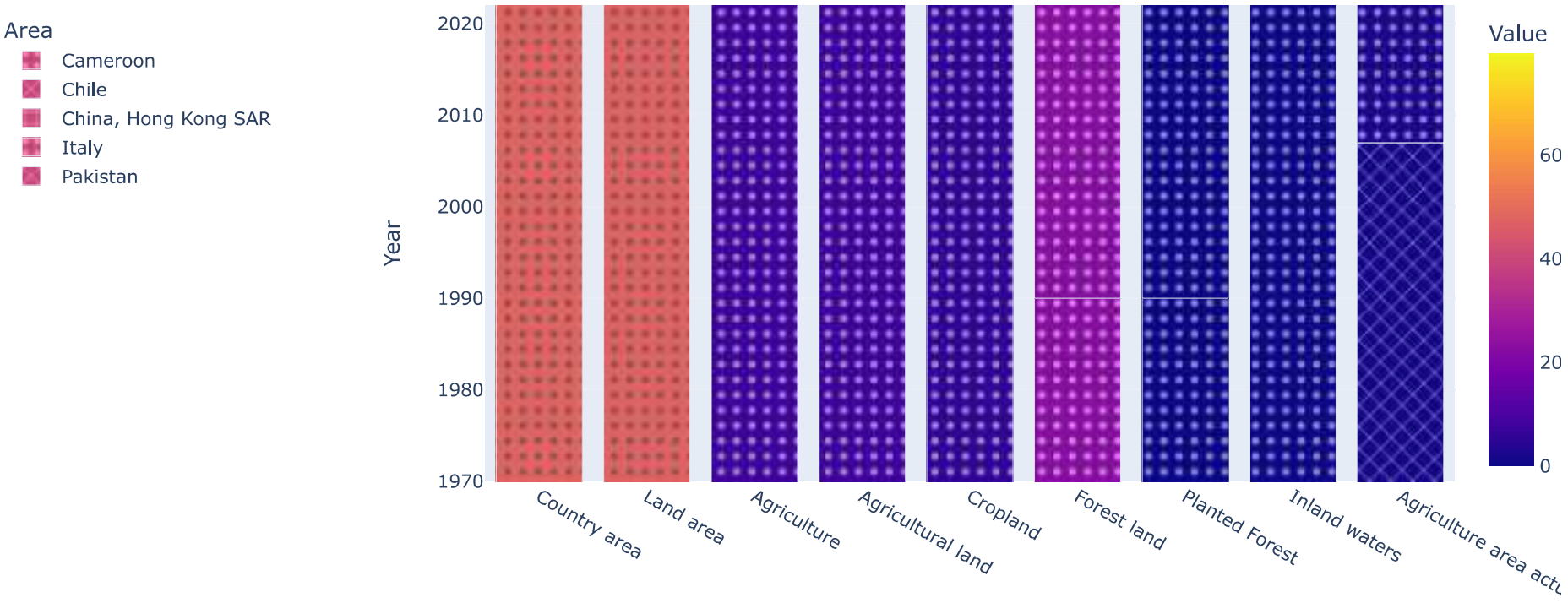
Out[ ]:

	0	1
0	Country	Mean
1	Pak	34583.710481
2	Italy	14436.351932
3	Chile	26012.186009
4	Cameroon	17587.760382

In [ ]:
```
type(x)
```

Out[ ]:
```
pandas.core.frame.DataFrame
```

In [ ]:
```
fig = px.bar(LU, x="Item", y="Year", color="Value", range_y=[1970, 2022],
             pattern_shape="Area", pattern_shape_sequence=[".", "x", "+"])
fig.update_layout(legend=dict(
    yanchor="top",
    y=0.99,
    xanchor="left",
    x=-0.5
))
fig.show()
```


Area
Cameroon
Chile
China, Hong Kong SAR
Italy
Pakistan
Year
2020
2010
2000
1990
1980
1970
Country area
Land area
Agriculture
Agricultural land
Cropland
Forest land
Planted Forest
Inland waters
Agriculture area actu
Value
60
40
20
0

Image

In [ ]: