```
In [1]: import pandas as pd
        import numpy as np
        import seaborn as sns
        import matplotlib.pyplot as plt
        sns.set_theme(style="white", palette="dark")
```

Loading and Transformations

The first dataset contains our target variable which is hdi, we have hdi data from previous years and the percentage growth among with information regarding population, density and area

```
In [2]: df_humanDevelopment=pd.read_csv('./hd_index.csv', on_bad_lines='skip')
        df_humanDevelopment.head(5)
```

Out[2]:

	place	pop2023	growthRate	area	country	cca3	cca2	ccn3	region	subregion	..
0	756	8796669	0.00643	41284.0	Switzerland	CHE	CH	756	Europe	Western Europe	..
1	578	5474360	0.00737	323802.0	Norway	NOR	NO	578	Europe	Northern Europe	..
2	352	375318	0.00649	103000.0	Iceland	ISL	IS	352	Europe	Northern Europe	..
3	344	7491609	0.00037	1104.0	Hong Kong	HKG	HK	344	Asia	Eastern Asia	..
4	36	26439111	0.01000	7692024.0	Australia	AUS	AU	36	Oceania	Australia and New Zealand	..

5 rows × 22 columns

```
In [3]: df_humanDevelopment.drop(columns=['hdi2020','hdi2019','hdi2010','hdi2000', 'hd
```

```
In [4]: df_humanDevelopment.shape
```

```
Out[4]: (96, 15)
```

The following datasets contain attributes related to the countries that may have an impact on the HDI, some of them are included in the calculation made by the United Nations, but I want to know the impact of other variables such as gender equality, living costs, education level, GDP per capita, among others.

In [5]:

```
#Education level by country
df_literacyRate=pd.read_csv('./literacyRate.csv', on_bad_lines='skip')
df_literacyRate.head()
```

Out[5]:

	place	pop2023	growthRate	area	country	cca3	cca2	ccn3	region	subregion
0	246	5545475.0	0.00085	338424.0	Finland	FIN	FI	246	Europe	Northern Europe
1	578	5474360.0	0.00737	323802.0	Norway	NOR	NO	578	Europe	Northern Europe
2	442	654768.0	0.01107	2586.0	Luxembourg	LUX	LU	442	Europe	Western Europe
3	20	80088.0	0.00331	468.0	Andorra	AND	AD	20	Europe	Southern Europe
4	304	56643.0	0.00314	2166086.0	Greenland	GRL	GL	304	North America	Northern America

In [6]:

```
##Removing the columns that repeat
df_literacyRate.drop(columns=['dataYear','rank','place', 'pop2023', 'growthRat
df_literacyRate.head()
```

Out[6]:

	country	latestRate
0	Finland	100.0
1	Norway	100.0
2	Luxembourg	100.0
3	Andorra	100.0
4	Greenland	100.0

In [7]:

```
df_literacyRate.shape
```

Out[7]:

```
(112, 2)
```

In [8]:

```
##Gender Equality by country (removing innecesary columns)
df_genderEquality=pd.read_csv('./gender_equality.csv', on_bad_lines='skip')
df_genderEquality.drop(columns=['ccn3', 'econ', 'education', 'health','polit',
df_genderEquality.head()
```

Out[8]:

	country	gendEqal2021
0	Iceland	0.892
1	Finland	0.861
2	Norway	0.849
3	New Zealand	0.840
4	Sweden	0.823

In [9]:

```
df_genderEquality.shape
```

Out[9]:

```
(73, 2)
```

In [10]:

```python
#GDP per country (I will remove the same columns than in previous datasets)
df_gdp=pd.read_csv('./gdp.csv', on_bad_lines='skip')
df_gdp.drop(columns=['ccn3','gdpDataYearUN','gdpPerCapitaWB','gdpDataYearWB','
df_gdp.head()
```

Out[10]:

	country	gdpPerCapitaUN
0	Monaco	234317.0
1	Liechtenstein	169260.0
2	Luxembourg	133745.0
3	Bermuda	112653.0
4	Ireland	101109.0

In [11]:

```python
df_gdp.shape
```

Out[11]:

```
(117, 2)
```

In [12]:

```python
##Living costs by country
df_livingCost=pd.read_csv('./living_cost.csv', on_bad_lines='skip')
df_livingCost.drop(columns=['ccn3','cl_numbeo','cl_plusRent_numbeo','cl_expati
df_livingCost.head()
```

Out[12]:

	country	cl_livingcost
0	Bermuda	NaN
1	Switzerland	2442.0
2	Norway	1951.0
3	Iceland	2166.0
4	Barbados	1261.0

In [13]:

```python
df_livingCost.shape
```

Out[13]:

```
(104, 2)
```

Looking at the shape of the df I already know that there are some countries missing in some of them, so I will only take the countries from our target variable to do the analysis, so I will merge my datasets into the dataset of the target variable to analyze only the countries on this one.

```
In [14]: dfnew=pd.merge(df_humanDevelopment, df_literacyRate, right_on=['country'], lef
         dfnew.head(5)
```

Out[14]:

	place	pop2023	growthRate	area	country	cca3	region	subregion	landAreaKm
0	756.0	8796669.0	0.00643	41284.0	Switzerland	CHE	Europe	Western Europe	39516.0
1	578.0	5474360.0	0.00737	323802.0	Norway	NOR	Europe	Northern Europe	364285.0
2	352.0	375318.0	0.00649	103000.0	Iceland	ISL	Europe	Northern Europe	100830.0
3	344.0	7491609.0	0.00037	1104.0	Hong Kong	HKG	Asia	Eastern Asia	1050.0
4	36.0	26439111.0	0.01000	7692024.0	Australia	AUS	Oceania	Australia and New Zealand	7692020.0

```
In [15]: dfnew.shape
```

```
Out[15]: (117, 16)
```

```
In [16]: dfnew1=pd.merge(dfnew, df_genderEquality, right_on=['country'], left_on=['coun
         dfnew1.head(5)
```

Out[16]:

	place	pop2023	growthRate	area	country	cca3	region	subregion	landAreaKm
0	756.0	8796669.0	0.00643	41284.0	Switzerland	CHE	Europe	Western Europe	39516.0
1	578.0	5474360.0	0.00737	323802.0	Norway	NOR	Europe	Northern Europe	364285.0
2	352.0	375318.0	0.00649	103000.0	Iceland	ISL	Europe	Northern Europe	100830.0
3	344.0	7491609.0	0.00037	1104.0	Hong Kong	HKG	Asia	Eastern Asia	1050.0
4	36.0	26439111.0	0.01000	7692024.0	Australia	AUS	Oceania	Australia and New Zealand	7692020.0

In [17]:
```
dfnew2=pd.merge(dfnew1, df_gdp, right_on=['country'], left_on=['country'], how
dfnew2.head(5)
```

Out[17]:

	place	pop2023	growthRate	area	country	cca3	region	subregion	landAreaKm
0	756.0	8796669.0	0.00643	41284.0	Switzerland	CHE	Europe	Western Europe	39516.0
1	578.0	5474360.0	0.00737	323802.0	Norway	NOR	Europe	Northern Europe	364285.0
2	352.0	375318.0	0.00649	103000.0	Iceland	ISL	Europe	Northern Europe	100830.0
3	344.0	7491609.0	0.00037	1104.0	Hong Kong	HKG	Asia	Eastern Asia	1050.0
4	36.0	26439111.0	0.01000	7692024.0	Australia	AUS	Oceania	Australia and New Zealand	7692020.0

In [18]:
```
df=pd.merge(dfnew2, df_livingCost, right_on=['country'], left_on=['country'],
df.head(5)
```

Out[18]:

	place	pop2023	growthRate	area	country	cca3	region	subregion	landAreaKm
0	756.0	8796669.0	0.00643	41284.0	Switzerland	CHE	Europe	Western Europe	39516.0
1	578.0	5474360.0	0.00737	323802.0	Norway	NOR	Europe	Northern Europe	364285.0
2	352.0	375318.0	0.00649	103000.0	Iceland	ISL	Europe	Northern Europe	100830.0
3	344.0	7491609.0	0.00037	1104.0	Hong Kong	HKG	Asia	Eastern Asia	1050.0
4	36.0	26439111.0	0.01000	7692024.0	Australia	AUS	Oceania	Australia and New Zealand	7692020.0

In [19]:
```
##Check how many nulls are in my dataset
df.isnull().sum()
```

Out[19]:
```
place             31
pop2023           31
growthRate        31
area              31
country            0
cca3              31
region            31
subregion         31
landAreaKm        31
density           31
densityMi         31
Rank              31
hdiTier           31
hdi2021           34
rank              31
latestRate        15
gendEqal2021      54
gdpPerCapitaUN    15
cl_livingcost     27
dtype: int64
```

In [20]:
```
## I will drop the null rows in hdi since this is my target variable
df.dropna(subset=['hdi2021'], inplace=True)
df.isnull().sum()
```

Out[20]:
```
place              0
pop2023            0
growthRate         0
area               0
country            0
cca3               0
region             0
subregion          0
landAreaKm         0
density            0
densityMi          0
Rank               0
hdiTier            0
hdi2021            0
rank               0
latestRate         3
gendEqal2021      22
gdpPerCapitaUN     1
cl_livingcost      1
dtype: int64
```

In [21]:
```
##For the nulls in other columns I will try to fill them with the average by r
df['gendEqal2021'] = df.groupby(['region'])['gendEqal2021']\
    .transform(lambda x: x.fillna(x.mean()))
```

```
In [22]: df['latestRate'] = df.groupby(['region'])['latestRate']\
             .transform(lambda x: x.fillna(x.mean()))
```

```
In [23]: df['gdpPerCapitaUN'] = df.groupby(['region'])['gdpPerCapitaUN']\
             .transform(lambda x: x.fillna(x.mean()))
```

```
In [24]: df['cl_livingcost'] = df.groupby(['region'])['cl_livingcost']\
             .transform(lambda x: x.fillna(x.mean()))
```

```
In [39]: ##Just to check the data types for all the columns
         df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 93 entries, 0 to 92
Data columns (total 19 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   place          93 non-null     float64
 1   pop2023        93 non-null     float64
 2   growthRate     93 non-null     float64
 3   area           93 non-null     float64
 4   country        93 non-null     object 
 5   cca3           93 non-null     object 
 6   region         93 non-null     object 
 7   subregion      93 non-null     object 
 8   landAreaKm     93 non-null     float64
 9   density        93 non-null     float64
 10  densityMi      93 non-null     float64
 11  Rank           93 non-null     float64
 12  hdiTier        93 non-null     object 
 13  hdi            93 non-null     float64
 14  rank           93 non-null     float64
 15  literacyRate   93 non-null     float64
 16  genderEqal     93 non-null     float64
 17  gdpPerCapita   93 non-null     float64
 18  livingCost     93 non-null     float64
dtypes: float64(14), object(5)
memory usage: 16.6+ KB
```

```
In [26]: #I'm renaming the important variables for better use
         df.rename(columns = {'latestRate':'literacyRate', 'hdi2021':'hdi','gendEqal202
```

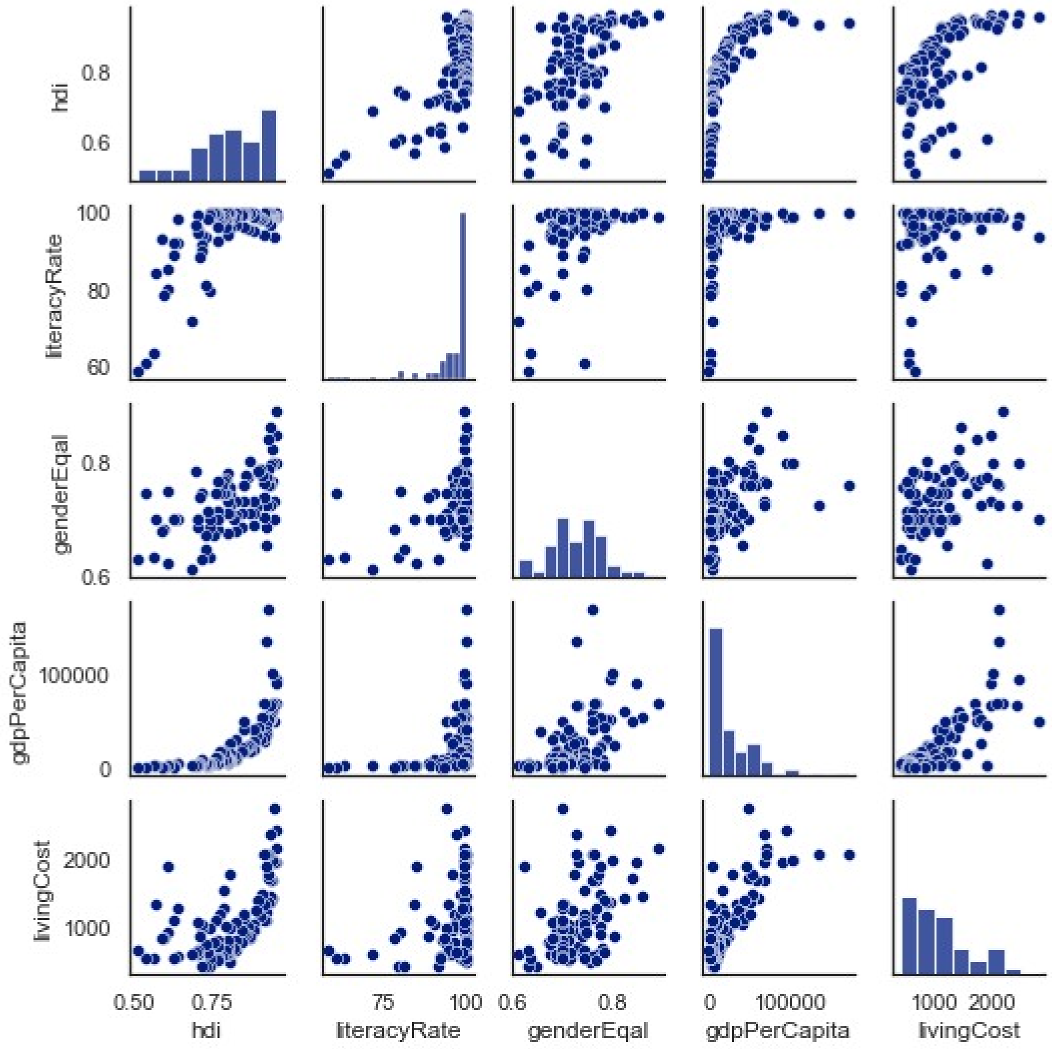
Charts

```
In [27]: #These are the variables that I want to correlate to my target variable
         corr = df[['hdi','literacyRate', 'genderEqal', 'gdpPerCapita', 'livingCost']].
         corr
```

Out[27]:

	hdi	literacyRate	genderEqal	gdpPerCapita	livingCost
hdi	1.000000	0.687715	0.564999	0.716685	0.586037
literacyRate	0.687715	1.000000	0.471526	0.341542	0.268297
genderEqal	0.564999	0.471526	1.000000	0.490218	0.440509
gdpPerCapita	0.716685	0.341542	0.490218	1.000000	0.781888
livingCost	0.586037	0.268297	0.440509	0.781888	1.000000

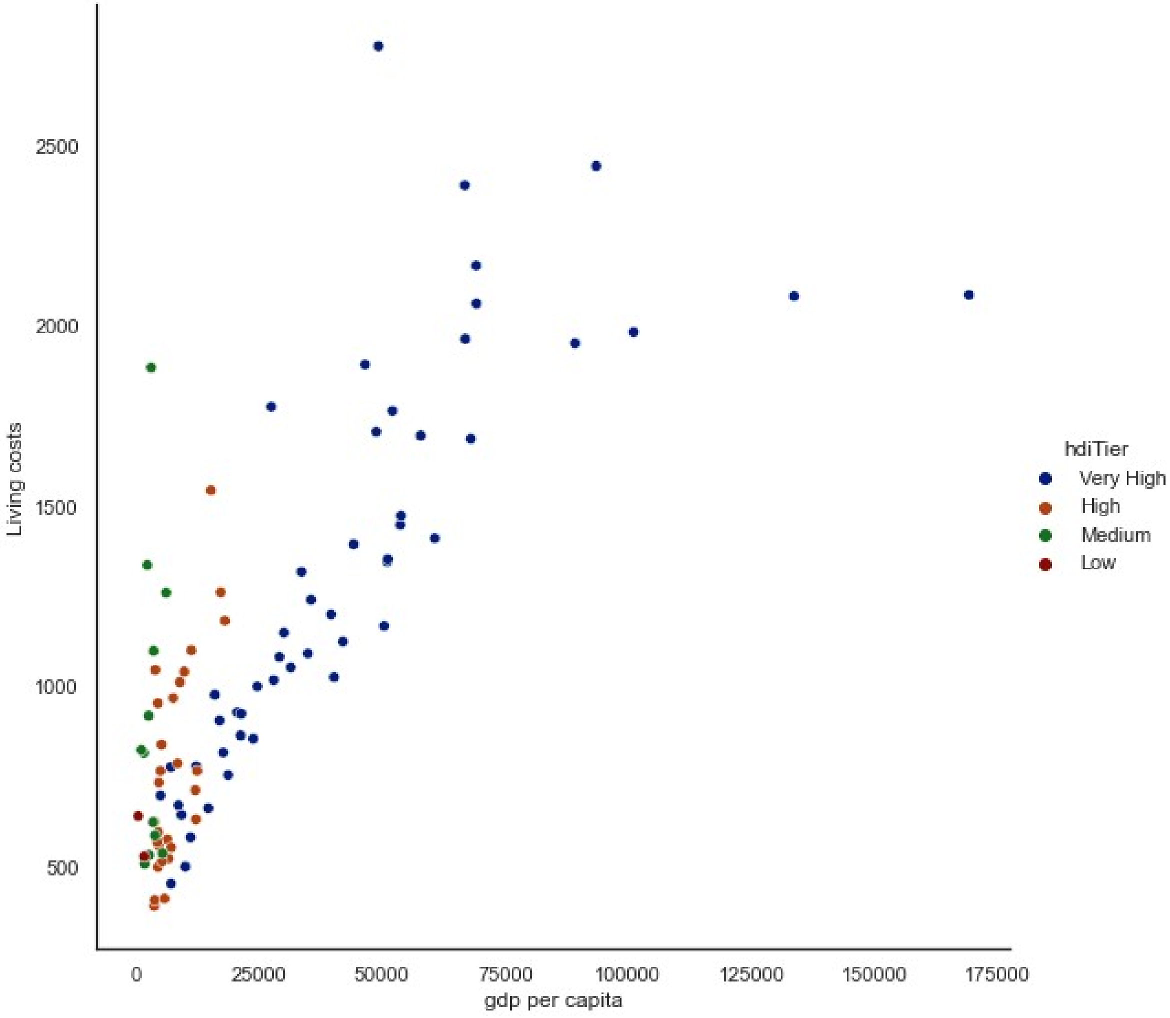
```
In [44]: sns.pairplot(df[['hdi','literacyRate', 'genderEqal', 'gdpPerCapita', 'livingCo
         plt.show()
```



Relationship between the living costs and gdp per capita based on the HDI tier

In [29]:

```
sns.relplot(data=df, x="gdpPerCapita", y="livingCost", hue="hdiTier",height=8)
```



What is the average gender equality rate and literacy rate group by tier hdi countries

In [30]:

```
df_genderHdiTier=df.groupby('hdiTier', as_index=False)['genderEqal', 'literacy
df_genderHdiTier['genderEqal']=(df_genderHdiTier['genderEqal']*100).round()
df_genderHdiTier['literacyRate']=(df_genderHdiTier['literacyRate']).round()
df_genderHdiTier.head()
```

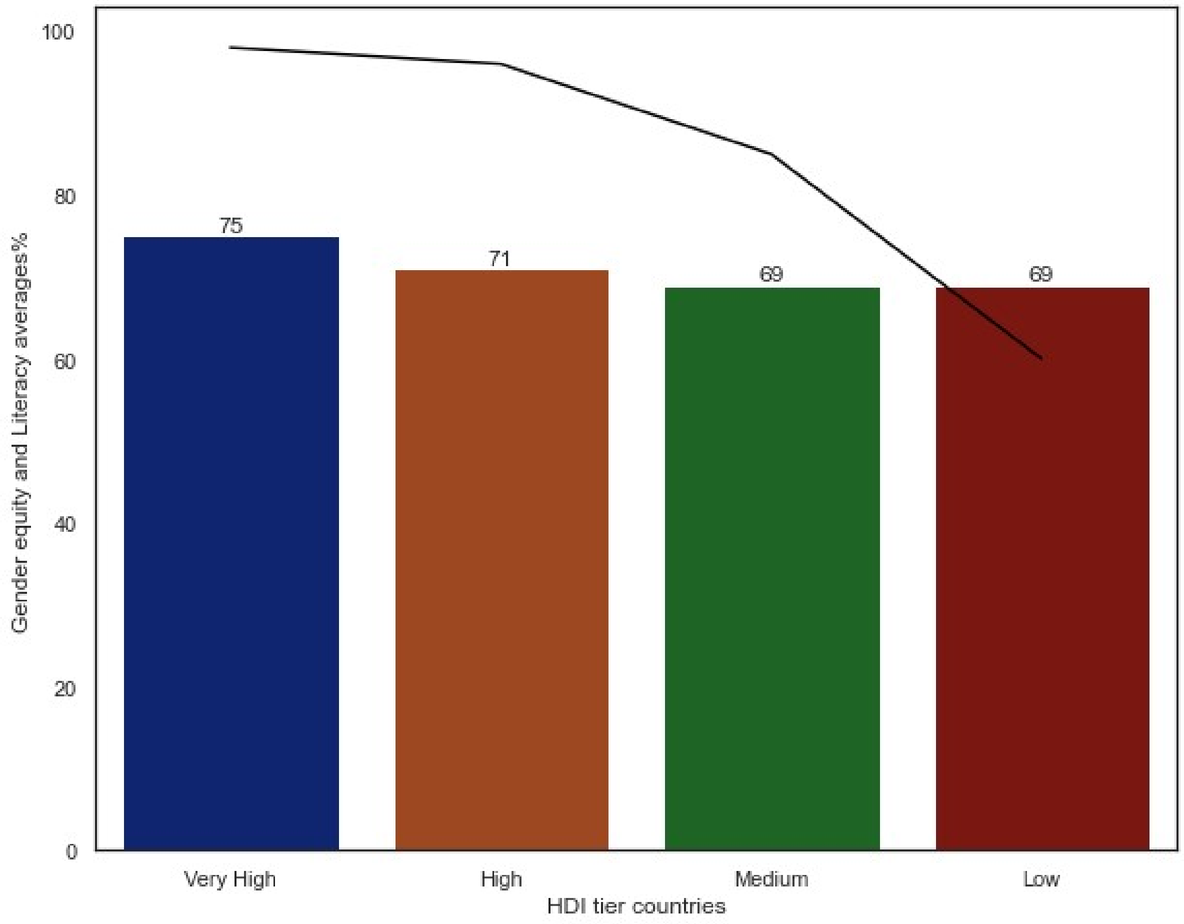
```
C:\Users\ASUS\AppData\Local\Temp\ipykernel_340\1195978896.py:1: FutureWarnin
g: Indexing with multiple keys (implicitly converted to a tuple of keys) will
be deprecated, use a list instead.
  df_genderHdiTier=df.groupby('hdiTier', as_index=False)['genderEqal', 'liter
acyRate'].mean().sort_values(by='genderEqal', ascending=False)
```

Out[30]:

	hdiTier	genderEqal	literacyRate
3	Very High	75.0	98.0
0	High	71.0	96.0
2	Medium	69.0	85.0
1	Low	69.0	60.0

In [31]:

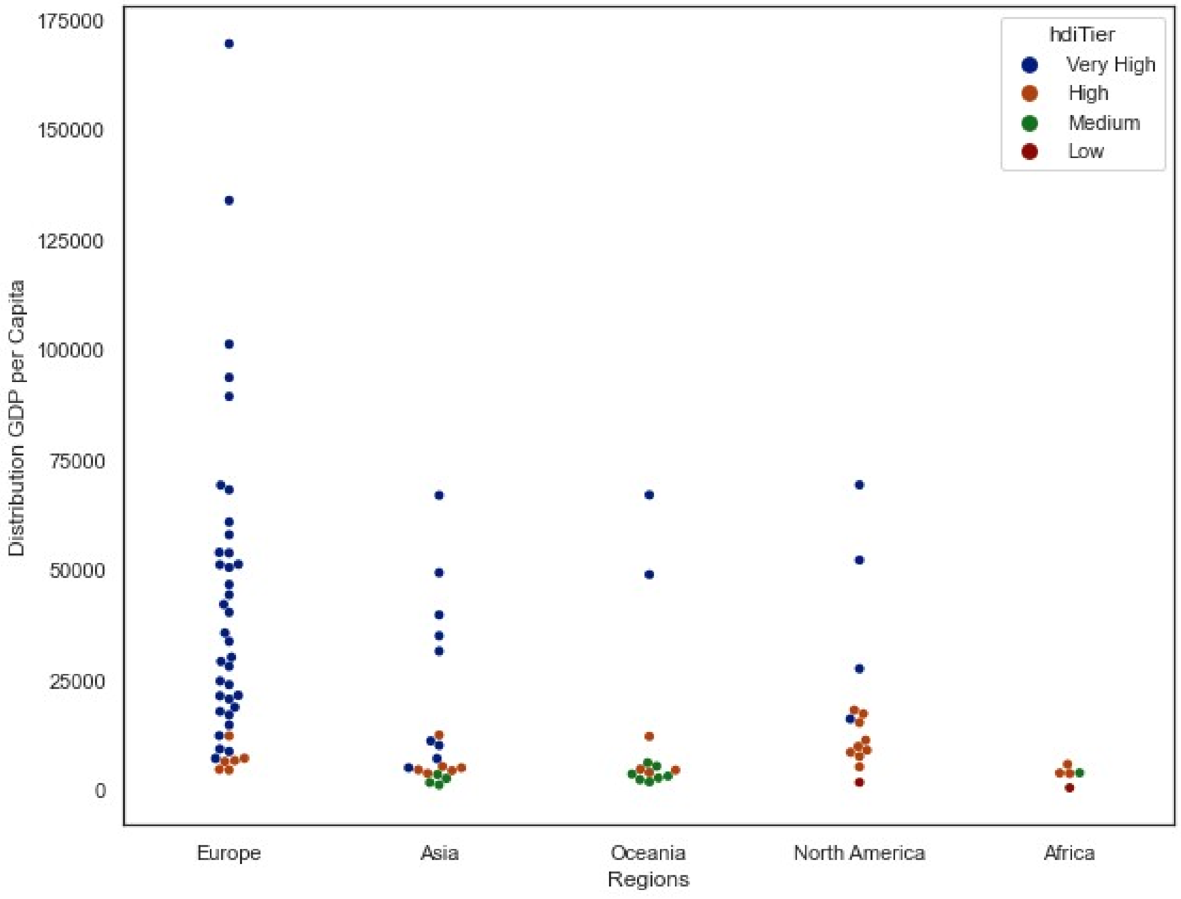
```
f, ax = plt.subplots(figsize=(10, 8))
ax1 = sns.lineplot(
    x='hdiTier',
    y='literacyRate', data=df_genderHdiTier,  sort=False, color='black')
sns.barplot(x="hdiTier", y="genderEqal", data=df_genderHdiTier, ax = ax1)
ax1.set(ylabel="Gender equity and Literacy averages%",
       xlabel="HDI tier countries")
for i in ax.containers:
    ax.bar_label(i,)
plt.show();
```



Distribution of the hdi among region taking into consideration the gdp per capita

In [32]:

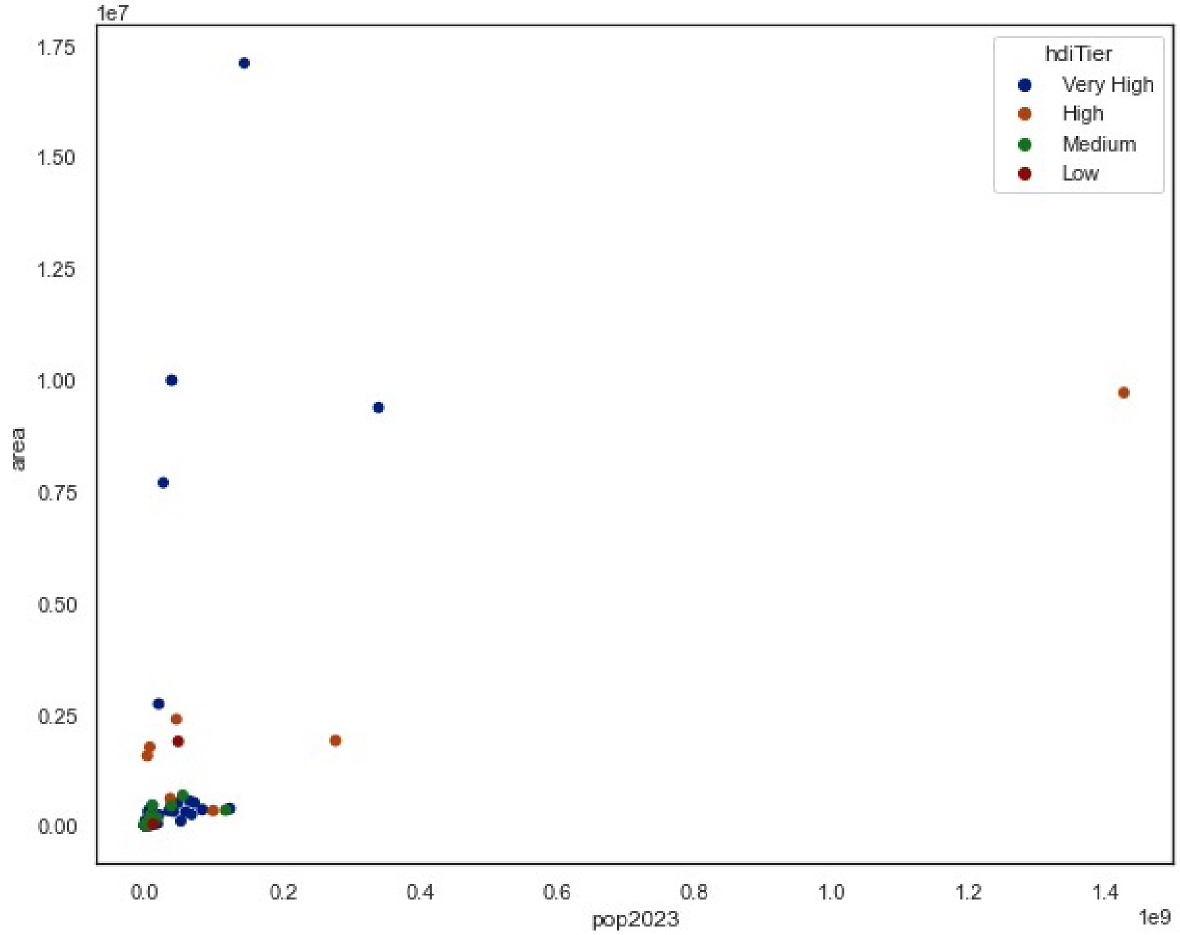
```
f, ax = plt.subplots(figsize=(10, 8))
g = sns.swarmplot(
    data=df,
    x="region", y="gdpPerCapita", hue="hdiTier",
)
ax.set(ylabel="Distribution GDP per Capita",
       xlabel="Regions");
```



Distribution of the hdi by area and population of the country

In [33]:

```
f, ax = plt.subplots(figsize=(10, 8))
sns.scatterplot(x="pop2023", y="area",
                hue="hdiTier", palette="dark",
                sizes=(1, 8), linewidth=0,
                data=df, ax=ax);
```



Top 10 countries with highest hdi and gdp per capita

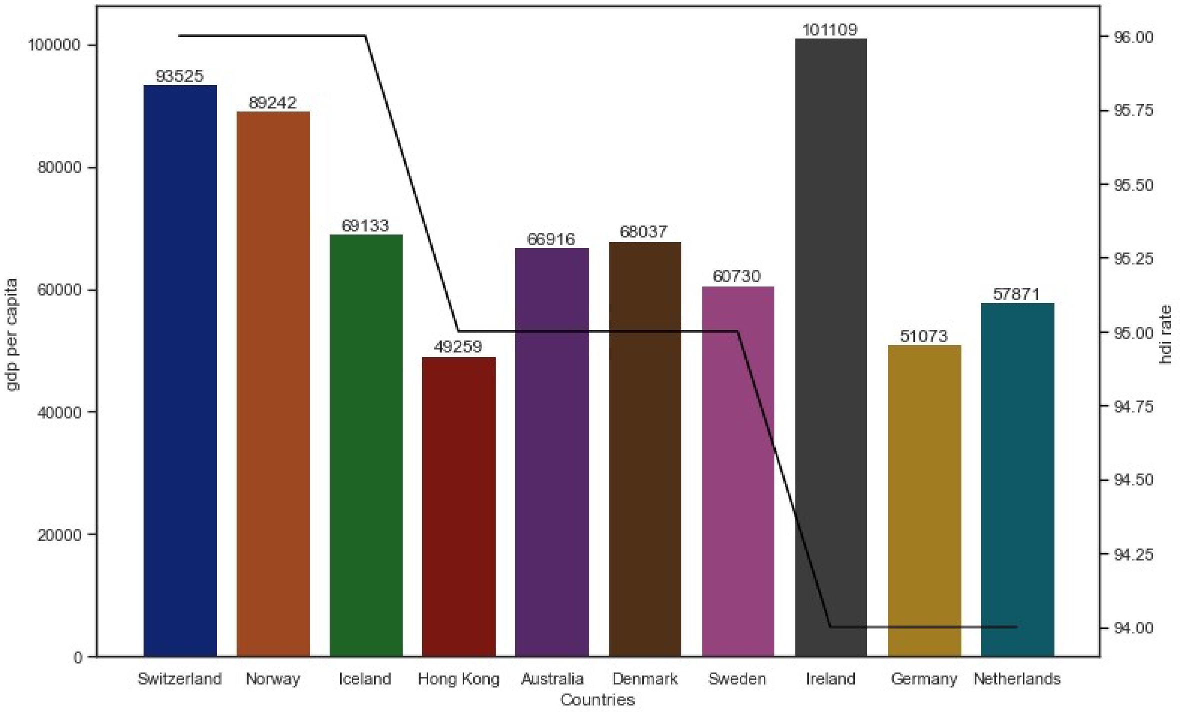
In [34]:

```
dfTop10=df.nlargest(10, ['hdi'])
dfTop10=dfTop10[['country', 'hdi','gdpPerCapita']]
dfTop10['hdi']=(dfTop10['hdi']*100).round()
dfTop10
```

Out[34]:

	country	hdi	gdpPerCapita
0	Switzerland	96.0	93525.0
1	Norway	96.0	89242.0
2	Iceland	96.0	69133.0
3	Hong Kong	95.0	49259.0
4	Australia	95.0	66916.0
5	Denmark	95.0	68037.0
6	Sweden	95.0	60730.0
7	Ireland	94.0	101109.0
8	Germany	94.0	51073.0
9	Netherlands	94.0	57871.0

```
In [35]: fig, ax1 = plt.subplots(figsize=(12,8))
         ax2=sns.barplot(x="country", y='gdpPerCapita', data=dfTop10)
         ax1.set(ylabel="gdp per capita", xlabel="Countries")
         ax1.tick_params(axis='y')
         ax2 = ax1.twinx()
         ax2=sns.lineplot(x='country',y='hdi', data=dfTop10,  sort=False, color='black'
         ax2.set(ylabel="hdi rate")
         ax2.tick_params(axis='y', color='black')
         for i in ax1.containers:
             ax1.bar_label(i,)
         plt.show();
```



10 countries with lowest hdi and gdp per capita

In [36]:

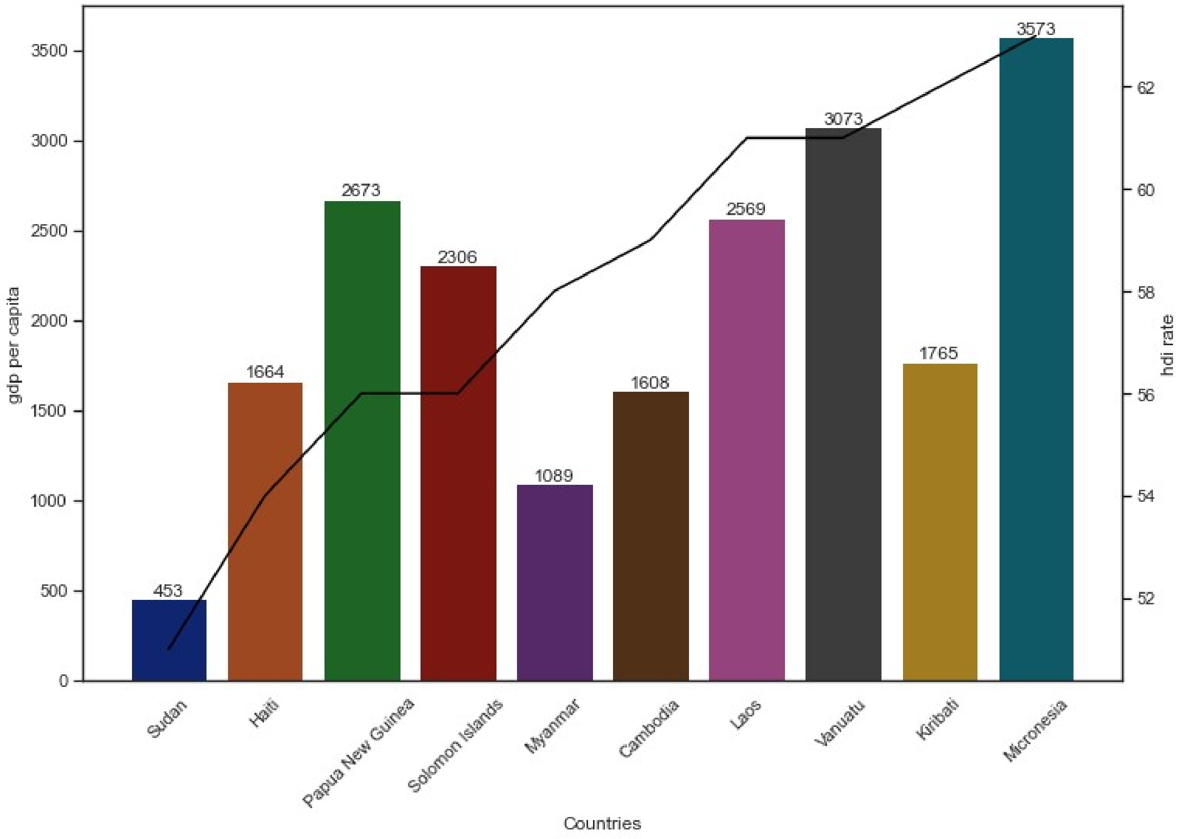
```
dfWorst10=df.nsmallest(10, ['hdi'])
dfWorst10=dfWorst10[['country', 'hdi','gdpPerCapita']]
dfWorst10['hdi']=(dfWorst10['hdi']*100).round()
dfWorst10
```

Out[36]:

	country	hdi	gdpPerCapita
92	Sudan	51.0	453.0
91	Haiti	54.0	1664.0
90	Papua New Guinea	56.0	2673.0
89	Solomon Islands	56.0	2306.0
88	Myanmar	58.0	1089.0
87	Cambodia	59.0	1608.0
85	Laos	61.0	2569.0
86	Vanuatu	61.0	3073.0
84	Kiribati	62.0	1765.0
83	Micronesia	63.0	3573.0

In [37]:

```
fig, ax1 = plt.subplots(figsize=(12,8))
ax2=sns.barplot(x="country", y='gdpPerCapita', data=dfWorst10)
ax1.set(ylabel="gdp per capita", xlabel="Countries")
ax1.tick_params(axis='y')
ax2 = ax1.twinx()
ax2=sns.lineplot(x='country',y='hdi', data=dfWorst10,  sort=False, color='blac
ax2.set(ylabel="hdi rate")
ax2.tick_params(axis='y', color='black')
for i in ax1.containers:
    ax1.bar_label(i,)
for j in ax1.get_xticklabels():
    j.set_rotation(45)
plt.show();
```



In [ ]: