In [1]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```
water_data = pd.read_csv("water_quality.csv")
```

In [3]:

```
water_data.head()
```

Out[3]:

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_carbon	T
0	NaN	204.890456	20791.31898	7.300212	368.516441	564.308654	10.379783	
1	3.716080	129.422921	18630.05786	6.635246	NaN	592.885359	15.180013	
2	8.099124	224.236259	19909.54173	9.275884	NaN	418.606213	16.868637	
3	8.316766	214.373394	22018.41744	8.059332	356.886136	363.266516	18.436525	
4	9.092223	181.101509	17978.98634	6.546600	310.135738	398.410813	11.558279	

In [4]:

```
water_data.tail()
```

Out[4]:

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_carbo
3271	4.668102	193.681736	47580.99160	7.166639	359.948574	526.424171	13.89441
3272	7.808856	193.553212	17329.80216	8.061362	NaN	392.449580	19.90322
3273	9.419510	175.762646	33155.57822	7.350233	NaN	432.044783	11.03907
3274	5.126763	230.603758	11983.86938	6.303357	NaN	402.883113	11.16894
3275	7.874671	195.102299	17404.17706	7.509306	NaN	327.459761	16.14036

In [5]:

```
water_data.shape
```

Out[5]:

```
(3276, 10)
```

In [6]:

```
water_data.columns
```

Out[6]:

```
Index(['ph', 'Hardness', 'Solids', 'Chloramines', 'Sulfate', 'Conductivit
y',
       'Organic_carbon', 'Trihalomethanes', 'Turbidity', 'Potability'],
      dtype='object')
```

In [7]:

```
water_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3276 entries, 0 to 3275
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   ph               2785 non-null   float64
 1   Hardness         3276 non-null   float64
 2   Solids           3276 non-null   float64
 3   Chloramines      3276 non-null   float64
 4   Sulfate          2495 non-null   float64
 5   Conductivity     3276 non-null   float64
 6   Organic_carbon   3276 non-null   float64
 7   Trihalomethanes  3114 non-null   float64
 8   Turbidity        3276 non-null   float64
 9   Potability       3276 non-null   int64  
dtypes: float64(9), int64(1)
memory usage: 256.1 KB
```

In [8]:

```
water_data.describe()
```

Out[8]:

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organ
count	2785.000000	3276.000000	3276.000000	3276.000000	2495.000000	3276.000000	32
mean	7.080795	196.369496	22014.092526	7.122277	333.775777	426.205111	
std	1.594320	32.879761	8768.570828	1.583085	41.416840	80.824064	
min	0.000000	47.432000	320.942611	0.352000	129.000000	181.483754	
25%	6.093092	176.850538	15666.690300	6.127421	307.699498	365.734414	
50%	7.036752	196.967627	20927.833605	7.130299	333.073546	421.884968	
75%	8.062066	216.667456	27332.762125	8.114887	359.950170	481.792305	
max	14.000000	323.124000	61227.196010	13.127000	481.030642	753.342620	

In [9]:

```
water_data.isnull().sum()
```

Out[9]:

```
ph                491
Hardness            0
Solids              0
Chloramines         0
Sulfate           781
Conductivity        0
Organic_carbon      0
Trihalomethanes   162
Turbidity           0
Potability          0
dtype: int64
```

In [10]:

```
water_data['ph'].fillna(water_data['ph'].mode(), inplace=True)
```

In [11]:

```
water_data['Sulfate'].fillna(water_data['Sulfate'].mode(), inplace=True)
```

In [12]:

```
water_data['Trihalomethanes'].fillna(water_data['Trihalomethanes'].mode(), inplace=True)
```

In [13]:

```
water_data.isnull().sum()
```

Out[13]:

```
ph                 65
Hardness            0
Solids              0
Chloramines         0
Sulfate           198
Conductivity        0
Organic_carbon      0
Trihalomethanes     7
Turbidity           0
Potability          0
dtype: int64
```

In [15]:

```
water_data.dropna(inplace = True)
```

In [16]:

```
water_data.corr()
```

Out[16]:

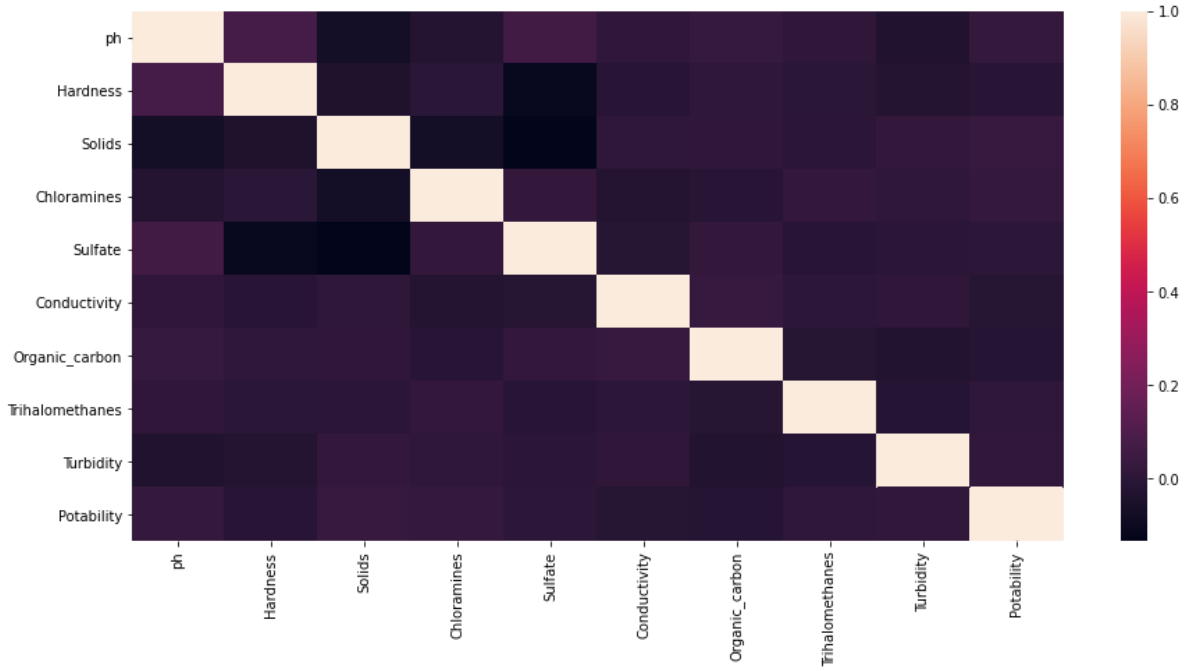
	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_
ph	1.000000	0.073546	-0.072102	-0.026261	0.063919	0.011440	0.(
Hardness	0.073546	1.000000	-0.043753	-0.007834	-0.107853	-0.010009	0.(
Solids	-0.072102	-0.043753	1.000000	-0.075168	-0.133952	0.007726	0.(
Chloramines	-0.026261	-0.007834	-0.075168	1.000000	0.019461	-0.026439	-0.(
Sulfate	0.063919	-0.107853	-0.133952	0.019461	1.000000	-0.017806	0.(
Conductivity	0.011440	-0.010009	0.007726	-0.026439	-0.017806	1.000000	0.(
Organic_carbon	0.029681	0.004045	0.010430	-0.012763	0.017272	0.032167	1.(
Trihalomethanes	0.008028	-0.009534	-0.003948	0.020067	-0.012869	-0.000832	-0.(
Turbidity	-0.034639	-0.025290	0.017453	0.005258	-0.004721	0.010878	-0.(
Potability	0.021105	-0.013547	0.030630	0.022761	0.001577	-0.016594	-0.(

In [19]:

```
plt.figure(figsize=(15,7))
sns.heatmap(water_data.corr())
```

Out[19]:

```
<AxesSubplot:>
```



In [23]:

```
water_data.Potability.unique()
```

Out[23]:

```
array([0, 1], dtype=int64)
```

In [22]:

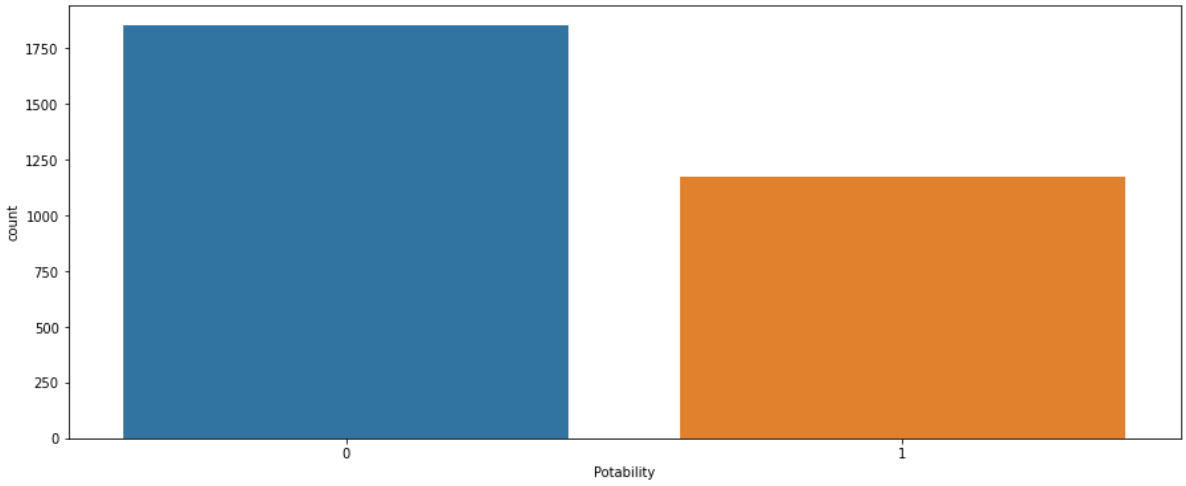
```
water_data.Potability.value_counts()
```

Out[22]:

```
0    1853
1    1173
Name: Potability, dtype: int64
```

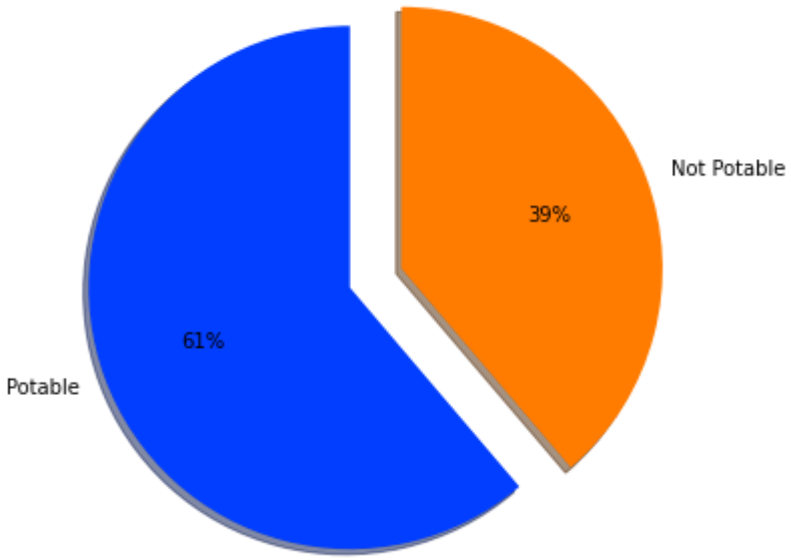
In [24]:

```
plt.figure(figsize=(15,6))
sns.countplot('Potability', data = water_data)
plt.xticks(rotation = 0)
plt.show()
```



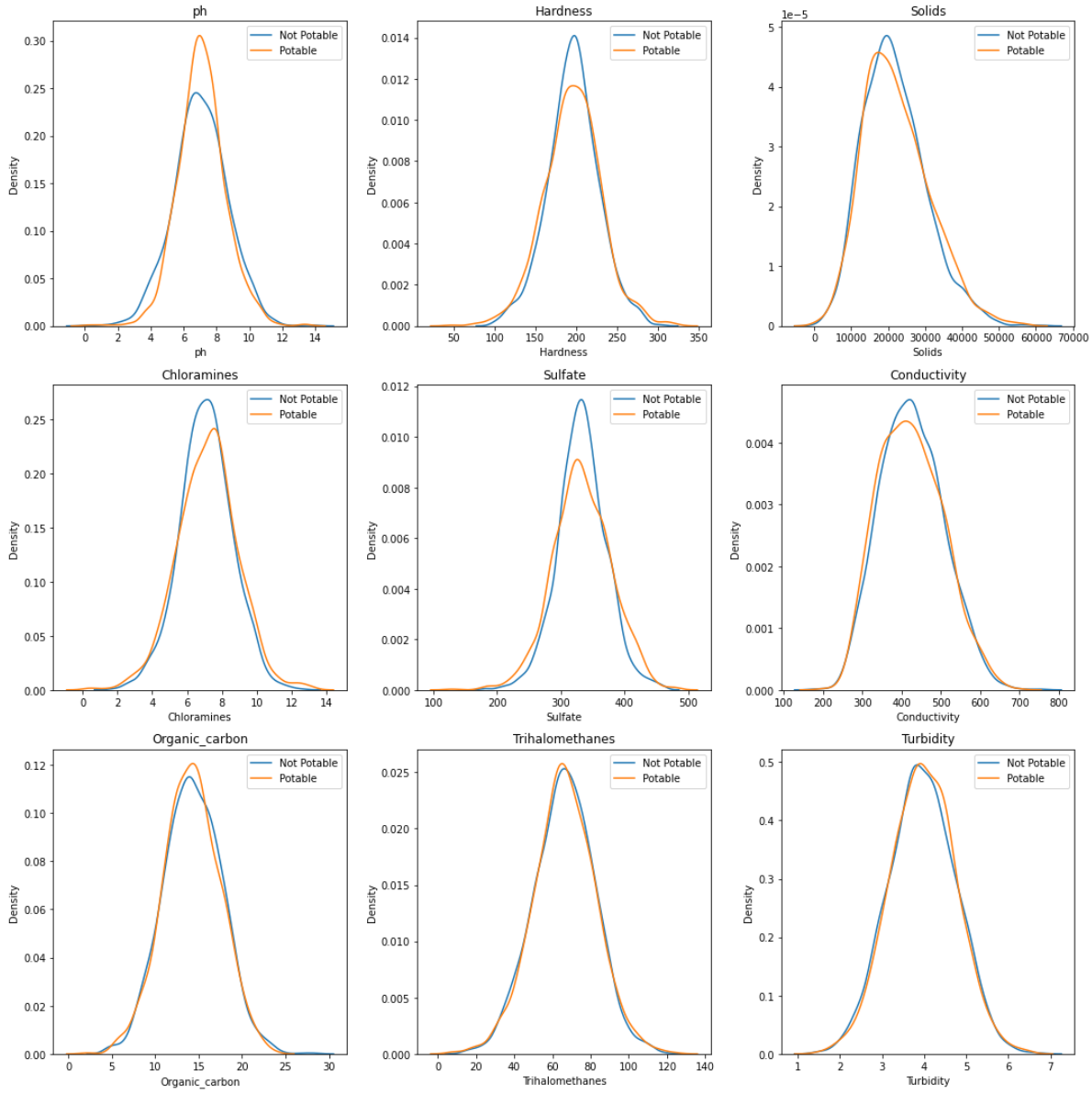
In [25]:

```
plt.figure(figsize=(15,6))
explode = [0.2,0.01]
colors = sns.color_palette('bright')
plt.pie(water_data['Potability'].value_counts(), labels=['Potable', 'Not Potable'],
        colors = colors, autopct = '%0.0f%%',  explode = explode, shadow = 'True',
        startangle = 90)
plt.show()
```



In [27]:

```
not_potable = water_data.query("Potability == 0")
potable = water_data.query("Potability == 1")
plt.figure(figsize = (15, 15))
for ax, col in enumerate(water_data.columns[:9]):
    plt.subplot(3, 3, ax + 1)
    plt.title(col)
    sns.kdeplot(x = not_potable[col], label = "Not Potable")
    sns.kdeplot(x = potable[col], label = "Potable")
    plt.legend()
plt.tight_layout()
```



In [28]:

```
x = water_data.drop("Potability", axis = 1).values
y = water_data["Potability"].values
```

In [29]:

```
x.shape
```

Out[29]:

```
(3026, 9)
```

In [30]:

```
y.shape
```

Out[30]:

```
(3026,)
```

In [31]:

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.20)
```

In [32]:

```
from sklearn.tree import DecisionTreeClassifier
classifier= DecisionTreeClassifier(criterion='entropy', random_state=0)
```

In [33]:

```
classifier.fit(x_train,y_train)
```

Out[33]:

```
DecisionTreeClassifier(criterion='entropy', random_state=0)
```

In [34]:

```
y_pred = classifier.predict(x_test)
```

In [35]:

```
print("Training Accuracy :", classifier.score(x_train, y_train))
print("Testing Accuracy :", classifier.score(x_test, y_test))
```

```
Training Accuracy : 1.0
Testing Accuracy : 0.6006600660066007
```

In [36]:

```
from sklearn.metrics import confusion_matrix
cm=confusion_matrix(y_test, y_pred)
```

In [37]:

```
cm
```

Out[37]:

```
array([[252, 113],
       [129, 112]], dtype=int64)
```

In [38]:

```
from sklearn.ensemble import RandomForestClassifier
classifier1= RandomForestClassifier(n_estimators= 10, criterion="entropy")
```

In [39]:

```
classifier1.fit(x_train, y_train)
```

Out[39]:

```
RandomForestClassifier(criterion='entropy', n_estimators=10)
```

In [40]:

```
y_pred = classifier1.predict(x_test)
```

In [41]:

```
print("Training Accuracy :", classifier1.score(x_train, y_train))
print("Testing Accuracy :", classifier1.score(x_test, y_test))
```

```
Training Accuracy : 0.9830578512396694
Testing Accuracy : 0.6386138613861386
```

In [42]:

```
cm=confusion_matrix(y_test, y_pred)
```

In [43]:

```
cm
```

Out[43]:

```
array([[319,  46],
       [173,  68]], dtype=int64)
```