ForestQuery into Global Deforestation, 1990 to 2016

Author: Kumari Meenakshi

ForestQuery is on a mission to combat deforestation around the world and to raise awareness about this topic and its impact on the environment. The data analysis team at ForestQuery has obtained data from the World Bank that includes forest area and total land area by country and year from 1990 to 2016, as well as a table of countries and the regions to which they belong.

I have used SQL to bring these tables together and to query them in an effort to find areas of concern as well as areas that present an opportunity to learn from successes.

1. GLOBAL SITUATION

According to the World Bank, the total forest area of the world was 41282694.9 sq.km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 sq. km, a loss of 132444 sq.km, or -3.21 %.
The forest area lost over this time period is slightly more than the entire land area of Peru listed for the year 2016 (which is 1279999.98 sq.km).

2. REGIONAL OUTLOOK

In 2016, the percent of the total land area of the world designated as forest was 31.37%. The region with the highest relative forestation was Latin America & Caribbean, with 46.16%, and the region with the lowest relative forestation was South Asia , with 17.51 % forestation.

In 1990, the percent of the total land area of the world designated as forest was 32.42%. The region with the highest relative forestation was Latin America & Caribbean, with 51.03%, and the region with the lowest relative forestation was Middle East & North Africa , with 1.78% forestation.

Table 2.1: Percent Forest Area by Region, 1990 & 2016:

Region	`1990 Forest Percentage	2016 Forest Percentage
North America	35.65%	36.04%
Sub-Saharan Africa	30.67%	28.79%
Middle East & North Africa	2.07%	1.78%
Latin America & Caribbean	51.03%	46.16%
East Asia & Pacific	25.78%	26.36%
South Asia	16.51%	17.51%
Europe & Central Asia	37.28%	38.04%

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America & Caribbean (dropped from 51.03% to 46.16%) and Sub-Saharan Africa (30.67 % to 28.79 %). All other regions actually increased in forest area over this time period. However, the drop in forest area in the two aforementioned regions was so large, the percent forest area of the world decreased over this time period from 32.42 % to 31.37 %.

3. **COUNTRY-LEVEL DETAIL**

A. SUCCESS STORIES

There is one particularly bright spot in the data at the country level, China. This country actually increased in forest area from 1990 to 2016 by 527229.062 sq.km. It would be interesting to study what has changed in this country over this time to drive this figure in the data higher. The country with the next largest increase in forest area from 1990 to 2016 was the United States, but it only saw an increase of 79200 sq.km, much lower than the figure for China.

China and United States are of course very large countries in total land area, so when we look at the largest percent change in forest area from 1990 to 2016, we aren't surprised to find a much smaller country listed at the top. Iceland increased in forest area by 213% from 1990 to 2016.

B. LARGEST CONCERNS

Which countries are seeing deforestation to the largest degree? We can answer this question in two ways. First, we can look at the absolute square kilometer decrease in forest area from 1990 to 2016. The following 3 countries had the largest decrease in forest area over the time period under consideration:

Table 3.1: Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016:

Country	**Region**	**Absolute Forest Area Change**
Brazil	Latin America & Caribbean	541510
Indonesia	East Asia & Pacific	282194
Myanmar	East Asia & Pacific	107234

The second way to consider which countries are of concern is to analyze the data by percent decrease.

Table 3.2: Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016:

Country	**Region**	**Pct Forest Area Change**
Togo	Sub-Saharan Africa	-75.45
Nigeria	Sub-Saharan Africa	-61.80
Uganda	Sub-Saharan Africa	-59.13
Mauritania	Sub-Saharan Africa	-46.75
Honduras	Latin America & Caribbean	-45.03

When we consider countries that decreased in forest area percentage the most between 1990 and 2016, we find that four of the top 5 countries on the list are in the region of Sub-Saharan Africa. The countries are Togo, Nigeria, Uganda, and Mauritania. The 5th country on the list is Honduras, which is in the Latin America & Caribbean region.

From the above analysis, we see that Nigeria is the only country that ranks in the top 5 both in terms of absolute square kilometer decrease in forest as well as percent decrease in forest area from 1990 to 2016. Therefore, this country has a significant opportunity ahead to stop the decline and hopefully spearhead remedial efforts.

C. QUARTILES

Table 3.3: Count of Countries Grouped by Forestation Percent Quartiles, 2016:

Quartile	Number of Countries
Less than 25%	98
25-50%	72
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the First quartile.

There were 9 countries in the top quartile in 2016. These are countries with a very high percentage of their land area designated as forest. The following is a list of countries and their respective forest land, denoted as a percentage.

Table 3.4: Top Quartile Countries, 2016:

Country	Region	Pct Designated as Forest
Solomon Islands	East Asia & Pacific	77.86
American Samoa	East Asia & Pacific	87.50
Gabon	Sub-Saharan Africa	90.04
Seychelles	Sub-Saharan Africa	88.41
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Palau	East Asia & Pacific	87.61
Lao PDR	East Asia & Pacific	82.11
Guyana	Latin America & Caribbean	83.90

Suriname	Latin America & Caribbean	98.26

4. RECOMMENDATIONS

When we analyse the data from the World Bank that includes forest area and total land area by country and year from 1990 to 2016, We found that there has been a decrease in total forest area from Year 1990 to 2016 which is around 3.21%. That decrease in area is almost 132444 sq.km which is larger than the area of country Peru.

If we compare the decrease in forest by different regions, then we can see that in Latin America & Caribbean and Sub-Saharan Africa regions there has been huge decline in forest area which has a negative impact on the world environment although other regions have been increased in their forest area.

In addition, when we analyse country level view of data then the top three countries which show decline in their forest area are Brazil, Indonesia, and Myanmar. In all the three countries Brazil lost the most forest land which is around 541510 sq. km and that is a big concern, so it is must for Brazil to apply great measures to save its forest- land and environment. Furthermore, In Sub-Saharan Africa region Nigeria is a country which shows decline of its forest land in both, as in percentage and actual amount of forest land. It is greatly required for Nigeria to follow steps to save the forest land in future.

But China and the United States are two major countries which show a great increase in their forest land which creates hope in view of declining forest in all other parts of the world, but they both are large countries in respect of total area. Whereas some small countries are really showing great positive results in increment of their forest land by taking appropriate steps at the right time and one of these countries is Iceland which shows almost 213% increase in forest land. If we do quartile analysis for percentage of forest land in different countries, we conclude that most of the countries that is 98 countries are in first quartiles, which means they have forest area less than 25% of total area. And only 9 countries are in the fourth quartile which have more than 75%.

After all the above analysis, regions like Latin America and Caribbeans and countries such as Brazil, listed in the above report which showed huge decline in their forest land must follow steps or measures to increase in their forest area and save the environment.

5. APPENDIX: SQL Queries Used

--**Creating a View**

```
drop view if exists forestation;
Create view Forestation as
Select
forest_area.country_code,forest_area.country_name,forest_area.year,forest_area.forest_area_
sqkm ,(land_area.total_area_sq_mi)* 2.59 as
total_area_sqkm,(forest_area.forest_area_sqkm/((land_area.total_area_sq_mi)* 2.59))*100
percent_forest_area,regions.income_group,regions.region
from forest_area
join land_area
on forest_area.country_code = land_area.country_code
and forest_area.year=land_area.year
join regions
on regions.country_code = forest_area.country_code
```

GLOBAL SITUATION

a. What was the total forest area (in sq km) of the world in 1990? Please keep in mind that you can use the country record denoted as “World" in the region table.

```
select forest_area_sqkm from forestation
where country_name = 'World' and year = 1990
```

Output: forest_area_sqkm = 41282694.9

b. What was the total forest area (in sq km) of the world in 2016? Please keep in mind that you can use the country record in the table is denoted as “World.”

```
select forest_area_sqkm from forestation
where country_name = 'World' and year = 2016
```

Output: forest_area_sqkm = 39958245.9

c. What was the change (in sq km) in the forest area of the world from 1990 to 2016?

```
With forest_area_1990 as
(select forest_area_sqkm area_1990 from forestation
where country_name = 'World' and year = 1990),
```

```
forest_area_2016 as
(select forest_area_sqkm as area_2016 from forestation
 where country_name = 'World' and year = 2016)

select area_1990 - area_2016 as difference
from forest_area_1990,forest_area_2016
```

Output: Difference - 1324449

d. What was the percent change in forest area of the world between 1990 and 2016?

```
with forest_area_1990 as
(select forest_area_sqkm area_1990 from forestation
where country_name = 'World' and year = 1990),

forest_area_2016 as
(select forest_area_sqkm as area_2016 from forestation
where country_name = 'World' and year = 2016),

diffrence as
(Select area_1990,area_2016, ((area_2016 - area_1990)/area_1990) * 100 as
percenatge_change
from forest_area_1990,forest_area_2016)

 select Round(percenatge_change::Numeric,2)
 from difference
```

Output: 3.21%

e. If you compare the amount of forest area lost between 1990 and 2016, to which country's total area in 2016 is it closest to?

```
select distinct country_name,total_area_sqkm
from forestation
where total_area_sqkm between 1270000 and 1350000
```

Output: **country_name = Peru , total_area_sqkm =** 1279999.9891

2. REGIONAL OUTLOOK

a. What was the percent forest of the entire world in 2016? Which region had the HIGHEST percent forest in 2016, and which had the LOWEST, to 2 decimal places?

```
select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016
from forestation
where Year = 2016 and
country_name = 'World'
```

output: **percentage_forest_2016** 31.3755709643095

```
with regional_percentage as
(select region, SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016
from forestation
where Year = 2016
group by region
order by percetage_forest_2016 desc)

select region,Round(percetage_forest_2016::Numeric,2)
from regional_percentage
```

Output: Region HIGHEST percent forest in 2016 - Latin America & Caribbean i.e 46.16%, Region Lowest percent forest in 2016- South Asia i.e - 17.51

b. What was the percent forest of the entire world in 1990? Which region had the HIGHEST percent forest in 1990, and which had the LOWEST, to 2 decimal places?

```
select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_1990
from forestation
where Year = 1990 and
region = 'World'
```

output: **percentage_forest_1990** 32.4222035575689

```
With regional_percentage as
(select region, SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percetage_forest_1990
from forestation
where Year = 1990 and region <> 'World'
group by region
order by percetage_forest_1990 desc)

select region,Round(percetage_forest_1990::Numeric,2)
from regional_percentage
```

Output: Region HIGHEST percent forest in 1990 - Latin America & Caribbean i.e 51.03%,

Region Lowest percent forest in 1990- Middle East & North Africa - 1.78%

c. Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?

```
With regional_percentage_2016 as
(select region, SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016
from forestation
where Year = 2016
group by region
order by percentage_forest_2016 desc),

regional_percentage_1990 as
(Select region, SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_1990
from forestation
where Year = 1990 and region <> 'World'
group by region
order by percentage_forest_1990 desc)

select regional_percentage_2016.region,
Round(percentage_forest_1990::Numeric,2) as Forest_1990,
Round(percentage_forest_2016::Numeric,2) as Forest_2016
from regional_percentage_2016
join regional_percentage_1990
on regional_percentage_2016.region = regional_percentage_1990.region
where regional_percentage_2016.region <> 'World'
group by regional_percentage_2016.region,
regional_percentage_2016.percentage_forest_2016,
regional_percentage_1990.percentage_forest_1990
```

Output:

Region	forest_1990	forest_2016
North America	35.65	36.04
Sub-Saharan Africa	30.67	28.79
Middle East & North Africa	2.07	1.78
Latin America & Caribbean	51.03	46.16
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.5
Europe & Central Asia	37.28	38.04

3. COUNTRY-LEVEL DETAIL

a. Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?

```
with forest_area_1990 as
(select Sum(forest_area_sqkm) area_1990,country_name as country
 from forestation
 where year = '1990' and forest_area_sqkm is not null
 group by 2),

 forest_area_2016 as
(select SUM(forest_area_sqkm) area_2016,country_name
 from forestation
 where year = '2016' and forest_area_sqkm is not null
 group by 2)

 select country_name,(area_1990-area_2016) as diffrence
 from forest_area_1990
 join forest_area_2016
 on forest_area_1990.country = forest_area_2016.country_name
 where country_name <> 'World'
 order by diffrence desc
 limit 5
```

Output:

country_name	diffrence
Brazil	541510
Indonesia	282193.9844
Myanmar	107234.0039
Nigeria	106506.00098
Tanzania	102320

b. Which 5 countries saw the largest percent decrease in forest area from 1990 to 2016? What was the percent change to 2 decimal places for each?

```
with forest_area_1990 as
(select Sum(forest_area_sqkm) area_1990,country_name as country
 from forestation
 where year = '1990' and forest_area_sqkm is not null
 group by 2),
```

```
 forest_area_2016 as
 (select SUM(forest_area_sqkm) area_2016,country_name
 from forestation
 where year = '2016' and forest_area_sqkm is not null
 group by 2),

diffrence as
( select country_name,(area_1990-area_2016)*100/(area_1990) as
diffrence_percentage
 from forest_area_1990
 join forest_area_2016
 on forest_area_1990.country = forest_area_2016.country_name
 where country_name <> 'World'
 order by diffrence_percentage desc
 limit 5)

select country_name,Round(diffrence_percentage::Numeric,2) as diff_per
from diffrence
```

output:

country_name	round
Togo	75.45
Nigeria	61.80
Uganda	59.13
Mauritania	46.75
Honduras	45.03

c. If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
   with forest_2016 as
   (select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016,country_name as country
   from forestation
   where country_name <> 'World' and year = 2016
    group by country_name),
```

```
 Max_Quartile as
 (select percentage_forest_2016,country,
  CASE
   WHEN percentage_forest_2016 >= 75 THEN '75-100%'
   WHEN percentage_forest_2016 >= 50 THEN '50-75%'
   WHEN percentage_forest_2016 >= 25 THEN '25-50%'
   ELSE 'less than 25%'
   END as quartiles

FROM forest_2016)

Select MAX(quartiles) from Max_Quartile
```

Output: less than 25%

d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

```
with forest_2016 as
(select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016,country_name as country,region from forestation
where country_name <> 'World' and year = 2016
group by country_name,region),



country_Quartile as
(select percentage_forest_2016,country,region,
CASE
   WHEN percentage_forest_2016 >= 75 THEN '75-100%'

   WHEN percentage_forest_2016 >= 50 THEN '50-75%'

   WHEN percentage_forest_2016 >= 25 THEN '25-50%'

   ELSE 'less than 25%'

   END as quartiles

FROM forest_2016)
```

```
Select country,region,Round(percentage_forest_2016::Numeric,2) as
forest_percentage from country_Quartile
where quartiles = '75-100%'
```

Output:

Country	region	forest_percentage
Solomon Islands	East Asia & Pacific	77.86
American Samoa	East Asia & Pacific	87.50
Gabon	Sub-Saharan Africa	90.04
Seychelles	Sub-Saharan Africa	88.41
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Palau	East Asia & Pacific	87.61
Lao PDR	East Asia & Pacific	82.11
Guyana	Latin America & Caribbean	83.90
Suriname	Latin America & Caribbean	98.26

Quartiles

```
with forest_2016 as
(select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016,country_name as country from forestation
where country_name <> 'World' and year = 2016
group by country_name),

  quartile_count as
(select percentage_forest_2016,country,
CASE
   WHEN percentage_forest_2016 >= 75 THEN '75-100%'

   WHEN percentage_forest_2016 >= 50 THEN '50-75%'

   WHEN percentage_forest_2016 >= 25 THEN '25-50%'
```

```
    ELSE 'less than 25%'

    END as quartiles

FROM forest_2016)

select quartiles, count(quartiles) from quartile_count
group by quartiles
```

Output:

quartiles	count
less than 25%	98
25-50%	72
50-75%	38
75-100%	9

f. How many countries had a percent forestation higher than the United States in 2016?

```
with forest_2016 as
(select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
percentage_forest_2016,country_name as country
from forestation
where country_name <> 'World' and year = 2016
group by country_name),

forest_unitedstates as
(select SUM(forest_area_sqkm)*100/SUM(total_area_sqkm) as
forest_2016_US
from forestation
where country_name = 'United States' and year = 2016)

select COUNT(country)
from forest_2016,forest_unitedstates
where percentage_forest_2016 > forest_2016_US
```

output:

count
94