Report for ForestQuery into Global Deforestation, 1990 to 2016

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.

The data analysis team has 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 km/sq in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km/sq, a loss of 1324449 km/sq, or 3.20%.

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 1279999.9891).

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 Middle East & North Africa , with 2.06 % 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 1.77 % forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
Latin America & Caribbean	51.03	46.16
Europe and Central Asia	37.28	38.04
North America	35.65	36.04
World	32.42	31.38
Sub-Saharan Africa	30.67	28.79
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.51
Middle East & North Africa	1.78	2.07

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 (30.65% to 28.72%). 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 km/sq. 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 km/sq, much lower than the figure for China.

Russian Federation and China 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 213.66 % 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	282193.98
Myanmar	East Asia & Pacific	107234.00
Nigeria	Sub-Saharan Africa	106506.00
Tanzania	Sub-Saharan Africa	102320

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	59.27
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
1	85
2	72
3	38
4	9

The largest number of countries in 2016 were found in the 1st quartile.

There were 3 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
Suriname	Latin America & Caribbean	98.25
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04

4. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.

- *What have you learned from the World Bank data?*
- *Which countries should we focus on over others?*

The things i have learned from the World Bank Data is that over the due course of time there are many countries that have an increase in the forest area inspite of increase in population of the world as a whole. Its interesting to see that India and China has increase in Forest area though the population is also increasing keeping the land area limited.There are alot of regions which includes many countries that have a decrease in forest area from 1990 to 2016.

The countries we should focus are mainly Brazil , Indonesia , Myanmar , Nigeria and Tanzania as they have a alot of forest land in 1990 but in 2016 it has dropped alot.Its a major concern for these countries as the more forest area they have it will lead to a better conditions and more balanced habitat for human beings as well as plants and animals due to which global concerns like global warming and other green house gases effects will be less making survival possible.

5. APPENDIX: SQL Queries Used

Create View as 'forestation'

```
create or replace view forestation as
select forest_area.*,
land_area.total_area_sq_mi * 2.59 as total_area_sqkm,
regions.region,
regions.income_group,
(forest_area.forest_area_sqkm/(land_area.total_area_sq_mi * 2.59)) * 100 as
forest_percent
from forest_area
join land_area
on (forest_area.country_name = land_area.country_name) AND (forest_area.year =
land_area.year)
join regions
on forest_area.country_code = regions.country_code
```

1. Global Situation

a.
```
select forest_area_sqkm as total_area
from forest_area
where country_name ='World' AND year = 1990
```

b.
```
select forest_area_sqkm as total_area
from forest_area
where country_name ='World' AND year = 2016
```

c.
```
select a1.year,a1.country_name, a2.year,a2.country_name,
a2.forest_area_sqkm - a1.forest_area_sqkm  as forest_area_change
from forest_area a1
join forest_area a2
on a1.country_name = a2.country_name
where a1.country_name ='World' AND a2.country_name = 'World' AND a1.year =
1990 AND a2.year = 2016
```

d.
```
select (a1.forest_area_sqkm - a2.forest_area_sqkm)/(a1.forest_area_sqkm) *
100  as percent_change
from forest_area a1
join forest_area a2
on a1.country_name = a2.country_name
where a1.country_name ='World' AND a1.year = 1990 AND a2.country_name
='World' AND a2.year = 2016
```

e.
```
 SELECT country_name, year, total_area_sq_mi*2.59
FROM land_area
WHERE year = 2016
AND total_area_sq_mi* 2.59 < 1324449
order by total_area_sq_mi DESC
limit 1
```

2. Regional Outlook

Create Table that shows Regions and percent forest area in 1990 and 2016

```
With s1 as
(select regions.region as regions_name,
SUM(forest_area.forest_area_sqkm)/SUM(land_area.total_area_sq_mi * 2.59) *100 as
percent_forest_1990
from regions
INNER join forest_area
on forest_area.country_code = regions.country_code
INNER join land_area
on land_area.country_name = forest_area.country_name
 and land_area.year = forest_area.year
where forest_area.year = 1990 and land_area.year = 1990
group by 1),

s2 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi * 2.59)  * 100 as percent_forest_2016
from regions
INNER join forest_area
on forest_area.country_code = regions.country_code
INNER join land_area
on land_area.country_name = forest_area.country_name
 and land_area.year = forest_area.year
where forest_area.year = 2016 and land_area.year = 2016
group by 1)

select s1.regions_name,CAST(s1.percent_forest_1990 as
Decimal(7,2)),CAST(s2.percent_forest_2016 as DECIMAL(7,2)) from s1
INNER JOIN s2
on s1.regions_name = s2.regions_name
order by percent_forest_2016 DESC
```

a. 1)

```
 With s1 as
(select regions.region as regions_name,
SUM(forest_area.forest_area_sqkm) /SUM(land_area.total_area_sq_mi * 2.59) *
100 as percent_forest_2016
from regions
INNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
 on land_area.country_name = regions.country_name
where forest_area.year = 2016 and land_area.year = 2016
group by 1)
select s1.regions_name , percent_forest_2016 from s1
where s1.regions_name = 'World'
```

a. 2)

```
With s1 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi * 2.59) * 100 as percent_forest_2016
from regions
INNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
 on land_area.country_name = regions.country_name
where forest_area.year = 2016 and land_area.year = 2016
group by 1)

select s1.regions_name , cast(percent_forest_2016 as Decimal(7,2)) from s1
order by 2 DESC
limit 1
```

a. 3)

```
With s1 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi *2.59) * 100 as percent_forest_2016
from regions
```

```
INNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
on land_area.country_name = regions.country_name
where forest_area.year = 2016 and land_area.year = 2016
group by 1)

select s1.regions_name , cast(percent_forest_2016 as Decimal(7,2)) from s1
order by 2
limit 1
```

b. 1)

```
With s1 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi * 2.59) * 100 as percent_forest_1990
from regions
INNER join forest_area
on forest_area.country_code = regions.country_code
INNER join land_area
on land_area.country_name = forest_area.country_name AND land_area.year =
forest_area.year
where forest_area.year = 1990 and land_area.year = 1990
group by 1)

select s1.regions_name , cast(percent_forest_1990 as Decimal(7,2)) from s1
where s1.regions_name = 'World'
```

b. 2)

```
With s1 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi * 2.59) * 100 as percent_forest_1990
from regions
INNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
```

```
 on land_area.country_name = regions.country_name
where forest_area.year = 1990 and land_area.year = 1990
group by 1)

select s1.regions_name , cast(percent_forest_1990 as Decimal(7,2)) from s1
order by 2  DESC
limit 1
```

b. 3)

```
With s1 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi * 2.59) * 100 as percent_forest_1990
from regions
IINNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
 on land_area.country_name = regions.country_name
where forest_area.year = 1990 and land_area.year = 1990
group by 1)

select s1.regions_name , cast(percent_forest_1990 as Decimal(7,2)) from s1
order by 2
limit 1
```

c.

```
With s1 as
(select regions.region as regions_name,
SUM(forest_area.forest_area_sqkm)/SUM(land_area.total_area_sq_mi * 2.59) *
100 as percent_forest_1990
from regions
INNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
on land_area.country_name = regions.country_name
where forest_area.year = 1990 and land_area.year = 1990
group by 1),
```

```
s2 as
(select regions.region as regions_name,SUM(forest_area.forest_area_sqkm)
/SUM(land_area.total_area_sq_mi * 2.59) * 100 as percent_forest_2016
from regions
INNER join forest_area
on forest_area.country_name = regions.country_name
INNER join land_area
on land_area.country_name = regions.country_name
where forest_area.year = 2016 and land_area.year = 2016
group by 1)

select s1.regions_name,percent_forest_2016 - percent_forest_1990 as
Dec_forest_area from s1
INNER JOIN s2
on s1.regions_name = s2.regions_name
where percent_forest_2016 - percent_forest_1990 < 0
```

3. Country Level Detail

To calculate large countries with highest land area

```
select country_name,(total_area_sq_mi * 2.59) as total_area from land_area
where (total_area_sq_mi * 2.59) IS NOT NULL AND  NOT country_name =
'World' AND year =2016
group by 1,2
order by total_area_sq_mi*2.59 DESC
limit 2
```

a.
```
With s1 as
(select country_name,forest_area_sqkm as forest_1990 from forest_area
```

```
where year = 1990),

s2 as
(select country_name,forest_area_sqkm as forest_2016 from forest_area
where year = 2016)

select regions.region, s1.country_name, s1.forest_1990 - s2.forest_2016 as Diff
from s1
INNER JOIN s2
on s1.country_name = s2.country_name
INNER join regions
on s1.country_name = regions.country_name
where ((s1.forest_1990 - s2.forest_2016) IS NOT NULL ) AND   NOT
s1.country_name = 'World'
order by 3 DESC
limit 5
```

b.

```
create or replace view percent_1990 as
 (select regions.region,forest_area.country_name, forest_area.year,
(sum(forest_area_sqkm) / sum(total_area_sq_mi*2.59))*100 as percent_forest
 from forest_area
INNER join land_area
 on forest_area.country_name = land_area.country_name and
 forest_area.year = land_area.year
INNER join regions
on regions.country_code = forest_area.country_code
 where forest_area.year = 1990 and land_area.year = 1990
 group by forest_area.country_name, forest_area.year,
forest_area_sqkm,regions.region)

create or replace view percent_2016 as
 (select regions.region,forest_area.country_name, forest_area.year,
(sum(forest_area_sqkm) / sum(total_area_sq_mi*2.59))*100 as percent_forest
 from forest_area
 INNER join land_area
 on forest_area.country_name = land_area.country_name and
 forest_area.year = land_area.year
INNER join regions
on regions.country_code = forest_area.country_code
```

```
 where forest_area.year = 2016 and land_area.year = 2016
 group by forest_area.country_name, forest_area.year,
forest_area_sqkm,regions.region)

SELECT percent_1990.country_name, percent_1990.region,
        Round((((percent_1990.percent_forest-
percent_2016.percent_forest)/(percent_1990.percent_forest))*100)::Numeric, 2)
AS
perc_change
FROM percent_1990
INNER JOIN percent_2016
ON percent_1990.country_name = percent_2016.country_name
WHERE percent_1990.percent_forest IS NOT NULL
AND percent_2016.percent_forest IS NOT NULL
AND percent_1990.country_name != 'World'
ORDER BY perc_change DESC
LIMIT 5;
```

C.

```
With s1 as
(select forest_area.country_name, forest_area.year, (sum(forest_area_sqkm) /
sum(total_area_sq_mi*2.59))*100 as percent_forest
 from forest_area
 INNER join land_area
 on forest_area.country_name = land_area.country_name and
 forest_area.year = land_area.year
 where forest_area.year = 2016 and land_area.year = 2016
 group by forest_area.country_name, forest_area.year, forest_area_sqkm)

Select distinct(quartiles),
        COUNT(country_name) OVER (PARTITION BY quartiles)
from
 (select s1.country_name,
 CASE
 WHEN percent_forest<25 THEN '0-25 (Q1)'
 WHEN percent_forest>=25 AND percent_forest<50 THEN '25-50 (Q2)'
 WHEN percent_forest>=50 AND percent_forest<75 THEN '50-75 (Q3)'
```

```
ELSE '75-100 (Q4)'
END AS quartiles
from s1
where  percent_forest IS NOT NULL AND s1.country_name != 'World'
AND s1.year = 2016) s2
```

d.

```
create or replace view quartile_2 as
(select regions.region,forest_area.country_name, forest_area.year,
(sum(forest_area_sqkm) / sum(total_area_sq_mi*2.59))*100 as percent_forest
 from forest_area
INNER join land_area
 on forest_area.country_name = land_area.country_name and
 forest_area.year = land_area.year
INNER join regions
on regions.country_code = forest_area.country_code
 where forest_area.year = 2016 and land_area.year = 2016
 group by forest_area.country_name, forest_area.year,
forest_area_sqkm,regions.region)

 Select distinct(quartiles), country_name,region,percent_forest
 from
 (select country_name,region,percent_forest,
 CASE
 WHEN percent_forest<25 THEN '0-25 (Q1)'
 WHEN percent_forest>=25 AND percent_forest<50 THEN '25-50 (Q2)'
 WHEN percent_forest>=50 AND percent_forest<75 THEN '50-75 (Q3)'
 ELSE '75-100 (Q4)'
 END AS quartiles
 from quartile_2
 where  percent_forest IS NOT NULL
 AND year = 2016) s2
 where quartiles = '75-100 (Q4)'
```

e.

```
create or replace view quartile_2 as
```

```
(select regions.region,forest_area.country_name, forest_area.year,
(sum(forest_area_sqkm) / sum(total_area_sq_mi*2.59))*100 as percent_forest
from forest_area
INNER join land_area
on forest_area.country_name = land_area.country_name and
forest_area.year = land_area.year
INNER join regions
on regions.country_code = forest_area.country_code
where forest_area.year = 2016 and land_area.year = 2016
group by forest_area.country_name, forest_area.year,
forest_area_sqkm,regions.region)

select country_name,region,percent_forest
from quartile_2
where percent_forest > (select percent_forest from quartile_2 where
country_name = 'United States')
```

QUERY USED FOR Top Quartile Countries, 2016:

```
create or replace view quartile_2 as
 (select regions.region,forest_area.country_name, forest_area.year,
(sum(forest_area_sqkm) / sum(total_area_sq_mi*2.59))*100 as percent_forest
 from forest_area
INNER join land_area
 on forest_area.country_name = land_area.country_name and
 forest_area.year = land_area.year
INNER join regions
on regions.country_code = forest_area.country_code
 where forest_area.year = 2016 and land_area.year = 2016
 group by forest_area.country_name, forest_area.year,
forest_area_sqkm,regions.region)

 Select distinct(quartiles), country_name,region,percent_forest
 from
(select country_name,region,percent_forest,
CASE
WHEN percent_forest<25 THEN '0-25 (Q1)'
```

```
WHEN percent_forest>=25 AND percent_forest<50 THEN '25-50 (Q2)'
WHEN percent_forest>=50 AND percent_forest<75 THEN '50-75 (Q3)'
ELSE '75-100 (Q4)'
END AS quartiles
from quartile_2
where  percent_forest IS NOT NULL
AND year = 2016) s2
where quartiles = '75-100 (Q4)'
Order by percent_forest
Limit 3
```