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 41,282,694.9 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 sqkm, a loss of 1,324,449 sqkm, or 3.21 %.

The forest area lost over this time period is slightly more than the entire land area of 1,279,999.99 sqkm listed for the year 2016 (which is Peru).

2. **REGIONAL OUTLOOK**

In 2016, the percentage of the total land area of the world designated as forest was 31.38%. 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 2.07% forestation.

In 1990, the percentage 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
Latin America & Caribbean	51.03	46.16
Europe & Central Asia	37.28	38.04
North America	36.65	36.04
World	32.42	31.38
Sub - Saharan Africa	30.67	28.79
East Asia & Pacific	25.78	26.36

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 _31.38%.

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 _527,229.06 sqkm_. 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 79,200 sqkm , much lower than the figure for China.

China and the 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 _213.66% 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	-541510.00
Indonesia	East Asia & Pacific	-282193.92
Myanmar	East Asia & Pacific	-107234.00
Nigeria	Sub-Saharan Africa	-106506.00
Tanzania	Sub-Saharan Africa	-102320.00

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**
0 - 25%	85
25% - 50%	72
50% - 75%	38
75% - 100%	9

The largest number of countries in 2016 were found in the _0-25%_ 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
Suriname	Latin America & Caribbean	98.26
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Seychelles	Sub-Saharan Africa	88.41
Palau	East Asia & Pacific	87.61
American Samoa	East Asia & Pacific	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Solomon Islands	East Asia & Pacific	77.86

4. RECOMMENDATIONS

Data shows that the world had a 3.21% loss of forest area, from 1990 to 2016, almost the same size as the entire land area of Peru. The regions with the highest deforestation are Latin America & Caribbean and Sub-Saharan Africa.
The countries where the forestation increased the most are China and the United States. Also, Iceland had a high increase in forest area.
Nigeria suffered a decrease in both forest area and forest percentage.
In the first quartile (0-25%) there are 85 countries. In the top quartile (75%-100%) there are only 9 countries, which means that these 9 countries have a high percentage of land area designated as forest.
The focus should be on the regions with highest deforestation rates (ex. Latin America & Caribbean Sub-Saharan Africa), as well as, the countries where the forestation had increased the most.

5. APPENDIX: SQL Queries Used

Create VIEW

```
DROP VIEW IF EXISTS forestation;
CREATE VIEW forestation
AS
(SELECT f.country_code, f.country_name, f.year, f.forest_area_sqkm,
l.total_area_sq_mi*2.59 as land_area_sq_km,
r.region,r.income_group
from forest_area f
join land_area l on f.country_code=l.country_code and f.year=l.year
join regions r on l.country_code=r.country_code);
```

1.a. What was the total forest area (in sq km) of the world in 1990?

```
SELECT forest_area_sqkm as total_forest_area_1990, country_name, year
FROM forestation
WHERE country_name = 'World' AND year = 1990;
```

1.b.What was the total forest area (in sq km) of the world in 2016?

```
SELECT forest_area_sqkm as total_forest_area_2016, country_name, year
FROM forestation
WHERE country_name = 'World' AND year = 2016;
```

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

```
with total_world_forest_area1990 as (
select country_name,
year,
forest_area_sqkm
from forestation
where country_name='World' and year=1990),
total_world_forest_area2016 as (
select country_name,
year,
forest_area_sqkm
from forestation
```

```
where country_name='World' and year=2016)
select a.country_name,(b.forest_area_sqkm-a.forest_area_sqkm) as lost_forest
from total_world_forest_area2016 a
JOIN total_world_forest_area1990 b
on a.country_name=b.country_name;
```

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

```
with total_world_forest_area1990 as (
select country_name,
year,
forest_area_sqkm
from forestation
where country_name='World' and year=1990),
total_world_forest_area2016 as (
select country_name,
year,
forest_area_sqkm
from forestation
where country_name='World' and year=2016),
lost as(
select a.country_name,(b.forest_area_sqkm-a.forest_area_sqkm) as lost_forest
from total_world_forest_area2016 a
JOIN total_world_forest_area1990 b
on a.country_name=b.country_name)

SELECT ROUND((l.lost_forest*100/ b.forest_area_sqkm)::numeric, 2) as percent_change,
a.country_name
FROM total_world_forest_area2016 a
JOIN total_world_forest_area1990 b
on a.country_name=b.country_name
JOIN lost l on l.country_name=a.country_name;
```

1.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 ROUND(land_area_sq_km::numeric, 2) as rounded_land_area_km, country_name,
year
FROM forestation
WHERE year = 2016 AND land_area_sq_km BETWEEN 1270000 AND 1320000
```

2.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?

```
with forest_percentage_2016 as
(select region,year, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_2016
from forestation
WHERE year = 2016
group by 1,2)
select round(forest_percentage_2016::numeric, 2) as rounded_highest_2016, region, year
from forest_percentage_2016
WHERE forest_percentage_2016 IS NOT NULL
group by 1, 2, 3
order by rounded_highest_2016 DESC;
```

```
with forest_percentage_2016 as
(select region,year, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_2016
from forestation
WHERE year = 2016
group by 1,2)
select round(forest_percentage_2016::numeric, 2) as rounded_lowest_2016, region, year
from forest_percentage_2016
WHERE forest_percentage_2016 IS NOT NULL
group by 1, 2, 3
order by rounded_lowest_2016;
```

2.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?

```
with forest_percentage_1990 as
(select region,year, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_1990
from forestation
WHERE year = 1990
group by 1,2)
select round(forest_percentage_1990::numeric, 2) as rounded_highest_1990, region, year
from forest_percentage_1990
WHERE forest_percentage_1990 IS NOT NULL
```

```
group by 1, 2, 3
order by rounded_highest_1990 DESC;

with forest_percentage_1990 as
(select region,year, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_1990
from forestation
WHERE year = 1990
group by 1,2)
select round(forest_percentage_1990::numeric, 2) as rounded_lowest_1990, region, year
from forest_percentage_1990
WHERE forest_percentage_1990 IS NOT NULL
group by 1, 2, 3
order by rounded_lowest_1990;
```

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

```
with forest_percentage_1990 as
(select region, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_1990
from forestation
WHERE year = 1990
group by 1),
forest_percentage_2016 as
(select region, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_2016
from forestation
WHERE year = 2016
group by 1),
joined_1990_2016 as
(select a.region, round(b.forest_percentage_1990::numeric,2) as forest_1990,
round(a.forest_percentage_2016::numeric,2) AS forest_2016
from forest_percentage_2016 a
join forest_percentage_1990 b
on a.region = b.region
WHERE a.region IS NOT NULL
group by 1, 2, 3
order by forest_1990, forest_2016)

select f.region, forest_1990, forest_2016, (forest_2016-forest_1990) as difference
from joined_1990_2016 j
```

```
join forestation f
on f.region = j.region
group by 1, 2, 3
order by difference;
```

3.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 countries_1990 as
(select country_name, region, forest_area_sqkm as c_1990
from forestation
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),
countries_2016 as
(select country_name, region, forest_area_sqkm as c_2016
from forestation
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL),
joined_1990_2016 as
(select a.country_name,a.region,  round(b.c_1990::numeric,2) as forest_1990,
round(a.c_2016::numeric,2) AS forest_2016
from countries_2016 a
join countries_1990 b
on a.country_name = b.country_name
WHERE a.country_name IS NOT NULL
group by 1, 2, 3,4
order by forest_1990, forest_2016)

select f.country_name,f.region, forest_1990, forest_2016, (forest_2016-forest_1990) as
difference
from joined_1990_2016 j
join forestation f
on f.country_name = j.country_name
where forest_1990 IS NOT NULL and forest_2016 IS NOT NULL and f.country_name != 'World'
group by 1, 2, 3,4
order by difference;
```

3.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 countries_1990 as
(select country_name, region, forest_area_sqkm as c_1990
```

```
from forestation
WHERE year = 1990 AND forest_area_sqkm IS NOT NULL),
countries_2016 as
(select country_name, region, forest_area_sqkm as c_2016
from forestation
WHERE year = 2016 AND forest_area_sqkm IS NOT NULL),
joined_1990_2016 as
(select a.country_name,a.region,  round(b.c_1990::numeric,2) as forest_1990,
round(a.c_2016::numeric,2) AS forest_2016
from countries_2016 a
join countries_1990 b
on a.country_name = b.country_name
WHERE a.country_name IS NOT NULL
group by 1, 2, 3,4
order by forest_1990, forest_2016)

SELECT country_name, countries_1990.region, Round(((c_2016 -
c_1990)*100/c_1990)::numeric,2) AS percent_change
FROM countries_1990
JOIN countries_2016
using (country_name)
ORDER BY percent_change
limit 5;
```

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

```
with forest_percentage_2016 as
(select country_name, region, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_2016
from forestation
WHERE year = 2016
group by 1,2),
qrt as
(select f.country_name, f.region, fp.forest_percentage_2016,
 CASE when fp.forest_percentage_2016 between 0 and 25 then '0-25%'
 when fp.forest_percentage_2016 between 25 and 50 then '25%-50%'
 when fp.forest_percentage_2016 between 50 and 75 then '50%-75%'
 else '75%-100%'
 end as quartiles
from forestation f
 join forest_percentage_2016 fp
 on f.region = fp.region
```

```
WHERE year = 2016 AND fp.forest_percentage_2016 IS NOT NULL AND f.country_name !=
'World')

select quartiles, COUNT(*)
from (select f.country_name, f.region, fp.forest_percentage_2016,
 CASE when fp.forest_percentage_2016 between 0 and 25 then '0-25%'
 when fp.forest_percentage_2016 between 25 and 50 then '25%-50%'
 when fp.forest_percentage_2016 between 50 and 75 then '50%-75%'
 else '75%-100%'
 end as quartiles
from forestation f
 join forest_percentage_2016 fp
 on f.country_name = fp.country_name
WHERE year = 2016 AND fp.forest_percentage_2016 IS NOT NULL AND f.country_name !=
'World') qrt
group by quartiles
order by quartiles;
```

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

```
with forest_percentage_2016 as
(select country_name, region, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_2016
from forestation
WHERE year = 2016
group by 1,2),
qrt as
(select f.country_name, f.region, fp.forest_percentage_2016,
 CASE when fp.forest_percentage_2016 between 0 and 25 then '0-25%'
 when fp.forest_percentage_2016 between 25 and 50 then '25%-50%'
 when fp.forest_percentage_2016 between 50 and 75 then '50%-75%'
 else '75%-100%'
 end as quartiles
from forestation f
 join forest_percentage_2016 fp
 on f.region = fp.region
WHERE year = 2016 AND fp.forest_percentage_2016 IS NOT NULL AND f.country_name !=
'World')

select quartiles, COUNT(*), country_name, region, round(forest_percentage_2016::numeric,2)
from (select f.country_name, f.region, fp.forest_percentage_2016,
 CASE when fp.forest_percentage_2016 between 0 and 25 then '0-25%'
```

```
 when fp.forest_percentage_2016 between 25 and 50 then '25%-50%'
 when fp.forest_percentage_2016 between 50 and 75 then '50%-75%'
 else '75%-100%'
 end as quartiles
from forestation f
 join forest_percentage_2016 fp
 on f.country_name = fp.country_name
WHERE year = 2016 AND fp.forest_percentage_2016 IS NOT NULL AND f.country_name !=
'World' ) qrt
group by quartiles, country_name, region, forest_percentage_2016
order by quartiles desc, round desc
limit 9;
```

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

```
with forest_percentage_2016 as
(select country_name, region, (sum(forest_area_sqkm)*100 / SUM(land_area_sq_km)) as
forest_percentage_2016
from forestation
WHERE year = 2016
group by 1,2)

select COUNT(*)
from forestation f
 join forest_percentage_2016 fp
 on f.country_name = fp.country_name
WHERE year = 2016 AND fp.forest_percentage_2016 IS NOT NULL AND f.country_name !=
'World' and fp.forest_percentage_2016 > 33.93;
```