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 41282694.90 sqkm in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.90 sqkm, a loss of 1324449 sqkm, or 3.2%.

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 1279999.99 sqkm).

2. **REGIONAL OUTLOOK**

In 2016, the percent 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 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
Latin America & Caribbean	51.03	46.16
Sub-Saharan Africa	30.67	28.79
World	32.42	31.38

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 527229.06 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 79200 sqkm, 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 213.66% 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 sqkm
Indonesia	East Asia & Pacific	282193.98 sqkm
Myanmar	East Asia & Pacific	107234 sqkm

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%

When we consider countries that decreased in forest area 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
1st	85

2nd	73
3rd	38
4th	9

The largest number of countries in 2016 were found in the 1st 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	98.25
Micronesia, Fed. Sts.	East Asia & Pacific	91.85
Gabon	Sub-Saharan Africa	90.03

4. RECOMMENDATIONS

The main takeaway from the examination of the World Bank data is that the total forest area of the world has been downscaled by 3.2% over the course of 26 years. The number itself is very alarming but if we look at countries that managed to increased their total forest area, we might learn something that will help in facing the deforestation problem worldwide.
Countries like Iceland, French Polynesia, Bahrain and Uruguay increased their forest areas all over 100% and as mentioned above Iceland more than 200%. Larger countries with smaller percentage increases but larger absolute increases like China, USA, India, Russia and Vietnam are worth mentioning here. It would be wise to see how these countries managed that and what strategies they used in order to achieve it.
On the other hand, there are countries with the opposite results and where our primary focus should be. Countries like Togo, Nigeria and Uganda lost more than half of their forests in just 26 years and along with Mauritania they are the top four countries in the list with countries that their total forest area was decreased. One issue that arises here is that the whole Sub-Saharan Africa has lost a big percentage of its forests and we have to find out why. Also, Brazil and Indonesia are two very large countries where, even though the forestation are decrease percentage is not as high as the previous group of countries, the total area of forests lost during these 26 years is very worrying and should be looked after.

5. Appendix: SQL queries used

1.Initial VIEW creation:

```
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 total_area_sqkm,
        l.total_area_sq_mi, r.region, r.income_group,
        (f.forest_area_sqkm*100)/(l.total_area_sq_mi*2.59) AS percentage
FROM forest_area f
JOIN land_area l
ON f.country_code = l.country_code
    AND f.year = l.year
JOIN regions r
ON f.country_code = r.country_code
```

1a. 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 CAST(SUM(forest_area_sqkm)AS DECIMAL(20,2)) AS world_total_forest_area
FROM forestation f
WHERE f.country_name = 'World' AND f.year = 1990
```

1b. 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 CAST(SUM(forest_area_sqkm)AS DECIMAL(20,2)) AS world_total_forest_area
FROM forestation f
WHERE f.country_name = 'World' AND f.year = 2016
```

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

```
SELECT SUM(a.forest_area_sqkm)-SUM(b.forest_area_sqkm) AS forest_area_dif
FROM forestation a,forestation b
WHERE a.year=1990 AND b.year=2016 AND a.country_name='World' AND
b.country_name='World'
```

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

```
SELECT CAST(SUM(a.forest_area_sqkm-
b.forest_area_sqkm)*100/SUM(a.forest_area_sqkm)AS DECIMAL (20,1)) as
forest_area_percent_dif
FROM forestation a,forestation b
```

```
WHERE a.year=1990 AND b.year=2016 AND a.country_name='World' AND
b.country_name='World'
```

1e. 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 f.country_name, CAST(f.total_area_sqkm AS DECIMAL (20,2)), f.year
FROM forestation f
WHERE year = 2016
AND total_area_sqkm < (SELECT
                        (a.forest_area_sqkm-b.forest_area_sqkm) AS
                        forest_area_dif
                        FROM forestation a, forestation b
                        WHERE a.year = 1990 AND b.year = 2016
                        AND a.country_name = 'World' AND b.country_name = 'World'
                        )
ORDER BY total_area_sqkm DESC
FETCH FIRST ROW ONLY
```

2.Create a table that shows the Regions and their percent forest area (sum of forest area divided by sum of land area) in 1990 and 2016.

```
SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
FROM forestation f
WHERE year = 1990 OR year = 2016
GROUP BY 1, 2
```

2a. 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?

World:

```
WITH percent_table AS (
    SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
    FROM forestation f
    WHERE year = 1990 OR year = 2016
    GROUP BY 1, 2)
SELECT *
FROM percent_table
WHERE year = 2016 AND region = 'World'
```

Region (Highest):

```
WITH percent_table AS (
    SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
    FROM forestation f
    WHERE year = 1990 OR year = 2016
    GROUP BY 1, 2)
SELECT *
FROM percent_table
WHERE year = 2016 AND region != 'World'
ORDER BY 3 DESC
LIMIT 1
```

Region (Lowest):

```
WITH percent_table AS (
    SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
    FROM forestation f
    WHERE year = 1990 OR year = 2016
    GROUP BY 1, 2)
SELECT *
FROM percent_table
WHERE year = 2016 AND region != 'World'
ORDER BY 3
LIMIT 1
```

2b. 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?

World:

```
WITH percent_table AS (
    SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
    FROM forestation f
    WHERE year = 1990 OR year = 2016
    GROUP BY 1, 2)
SELECT *
FROM percent_table
WHERE year = 1990 AND region = 'World'
```

Region (Highest):

```
WITH percent_table AS (
    SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
    FROM forestation f
    WHERE year = 1990 OR year = 2016
    GROUP BY 1, 2)
SELECT *
FROM percent_table
WHERE year = 1990 AND region != 'World'
ORDER BY 3 DESC
LIMIT 1
```

Region (Lowest):

```
WITH percent_table AS (
    SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percent_forest_area
    FROM forestation f
    WHERE year = 1990 OR year = 2016
    GROUP BY 1, 2)
SELECT *
FROM percent_table
WHERE year = 1990 AND region != 'World'
ORDER BY 3
LIMIT 1
```

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

```
WITH percentage90 AS (
SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percentage1990
FROM forestation f
WHERE f.year = 1990
GROUP BY 1,2),

percentage16 AS (
```

```
SELECT f.region, f.year,
CAST((SUM(f.forest_area_sqkm)*100/SUM(f.total_area_sqkm)) AS DECIMAL(20,2)) as
percentage2016
FROM forestation f
WHERE f.year = 2016
GROUP BY 1,2)

SELECT p1.region, p1.percentage1990, p2.percentage2016
FROM percentage90 p1
JOIN percentage16 p2
ON p1.region= p2.region
WHERE p1.percentage1990 > p2.percentage2016
GROUP BY 1,2,3
```

3A. SUCCESS STORIES:
Absolute values:

```
SELECT a.country_name,  a.region, CAST(SUM(a.forest_area_sqkm)-
SUM(b.forest_area_sqkm)AS DECIMAL(20,2)) as forest_area_dif
FROM forestation a
JOIN forestation b
ON a.country_name = b.country_name
WHERE a.year = 2016 AND b.year = 1990 AND a.forest_area_sqkm is not null AND
b.forest_area_sqkm is not null AND b.country_name <> 'World'
GROUP BY 1,2
ORDER BY 3 DESC
LIMIT 2
```

By percentage:

```
SELECT a.country_name, a.region, ABS(CAST(((SUM(b.forest_area_sqkm)-
SUM(a.forest_area_sqkm))*100/SUM(b.forest_area_sqkm))AS DECIMAL(20,2))) as
forest_area_dif
FROM forestation a
JOIN forestation b
ON a.country_name = b.country_name
WHERE a.year = 2016 AND b.year = 1990 AND a.forest_area_sqkm is not null AND
b.forest_area_sqkm is not null AND a.country_name <> 'World' AND b.country_name
<> 'World'
GROUP BY 1,2
ORDER BY 3 DESC
LIMIT 1
```

3a. Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the difference in forest area for each?

```
SELECT a.country_name,  a.region, CAST(SUM(b.forest_area_sqkm)-
SUM(a.forest_area_sqkm)AS DECIMAL(20,2)) as forest_area_dif
FROM forestation a
JOIN forestation b
ON a.country_name = b.country_name
WHERE a.year = 2016 AND b.year = 1990 AND a.forest_area_sqkm is not null AND
b.forest_area_sqkm is not null AND b.country_name <> 'World'
GROUP BY 1,2
ORDER BY 3 DESC
LIMIT 5
```

3b. 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?

```
SELECT a.country_name,  a.region, CAST((SUM(b.forest_area_sqkm)-
SUM(a.forest_area_sqkm))*100/SUM(b.forest_area_sqkm) AS DECIMAL(20,2)) as
forest_area_dif
FROM forestation a
JOIN forestation b
ON a.country_name = b.country_name
WHERE a.year = 2016 AND b.year = 1990 AND a.forest_area_sqkm is not null AND
b.forest_area_sqkm is not null AND b.country_name <> 'World'
GROUP BY 1,2
ORDER BY 3 DESC
LIMIT 5
```

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

```
SELECT
        COUNT (CASE WHEN f.percentage < 25 THEN '1st Percentile' ELSE NULL END)
        AS first_quartile,
        COUNT (CASE WHEN f.percentage >= 25 AND f.percentage < 50 THEN '2nd
        Percentile' ELSE NULL END) AS second_quartile,
        COUNT (CASE WHEN f.percentage >= 50 AND f.percentage < 75 THEN
        '3rdPercentile' ELSE NULL END) AS third_quartile,
        COUNT (CASE WHEN f.percentage >= 75 THEN '4th Percentile' ELSE NULL END)
        AS fourth_quartile
FROM forestation f
WHERE f.year = 2016
```

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

```sql
SELECT f.country_name,f.region, f.percentage
FROM forestation f
WHERE f.year = 2016 AND f.percentage IS NOT NULL AND f.percentage >=75
ORDER BY 3 DESC
```

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

```sql
WITH USA AS (
SELECT f.country_name,  f.percentage
FROM forestation f
WHERE f.year = 2016 AND f.country_name = 'United States')

SELECT COUNT(*)
FROM forestation f, USA u
WHERE f.year = 2016 AND f.percentage IS NOT NULL AND f.percentage > u.percentage
```