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 sqkm** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 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 **1279999.99 sqkm** listed for the year 2016 (which is **Peru**).

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	STATUS
East Asia & Pacific	**25.78**	**26.36**	**INCREASED**
Europe & Central Asia	**37.28**	**38.04**	**INCREASED**
Latin America & Caribbean	**51.03**	**46.16**	**DECREASED**
Middle East & North Africa	**1.78**	**2.07**	**INCREASED**
North America	**35.65**	**36.04**	**INCREASED**
South Asia	**16.51**	**17.51**	**INCREASED**
Sub-Saharan Africa	**30.67**	**28.79**	**DECREASED**
World	**32.42**	**31.38**	**DECREASED**

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 **79200.00 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**	**282193.98**
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**	**59.27**
Mauritania	**Sub-Saharan Africa**	**46.75**
Honduras	**Latin America & Caribbean**	**45.03**

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
quartile_1	**85**
quartile_2	**72**
quartile_3	**38**
quartile_4	**9**

The largest number of countries in 2016 were found in the **quartile_1** 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**

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

There are **94** countries that had a higher forestation percent.

5. 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?*

Global Situation

While the majority of regions are on a growth path, a few regions are overlooking these achievements. A closer look at the East Asia & Pacific region shows that the outlook is only positive thanks to the enormous contribution of China.

Situation Africa

The data show that the situation in sub-Saharan Africa needs to be closely monitored. Once desertification due to deforestation takes hold, many more environmental problems will follow.

It is vital to work with local communities and community leaders to create an understanding of sustainable forest management. In addition, the affected communities in this region often practice slash-and-burn logging. This is a common mistake that needs to be corrected.

Situation South America

In this region, the local authorities are for the most part actively involved in deforestation in order to gain agricultural land. This development should be counteracted as soon as possible. The soil quality in this region is poor, and only thanks to the winds that bring sand from sub-Saharan Africa and the minerals and nutrients it contains can this region flourish. However, once the forest is gone, agriculture is only possible through the application of fertilizers over large areas. This is not sustainable at all and aggravates the looming phosphorus crisis.

Countries to be monitored

Generally in large countries with an extensive forest reserve, but where more and more wood is felled or burned. These countries have a responsibility towards global forest health. And they must be encouraged to take up this challenge.

Countries of concern are Togo, Nigeria, Uganda, Maritane and Honduras, as they have the highest percentage of forest area loss. Other countries with the highest actual levels of forest dieback are Brazil, Indonesia, Myanmar, Nigeria and Tanzania.

Appendix

6. CODE for project

View

```
CREATE VIEW forestation
AS
 SELECT f.country_code,
 f.country_name,
 f.year,
 f.forest_area_sqkm,
 land.total_area_sq_mi,
 land.total_area_sq_mi * 2.59 AS total_area_sqkm,
 r.region,
 r.income_group,
 ( Sum(f.forest_area_sqkm) / Sum(land.total_area_sq_mi * 2.59) ) * 100
 forest_percent
 FROM forest_area f
 INNER JOIN land_area land
 ON land.country_code = f.country_code
 AND land.year = f.year
 INNER JOIN regions r
 ON r.country_code = land.country_code
 GROUP BY f.country_code,
 f.country_name,
 f.year,
 f.forest_area_sqkm,
 land.total_area_sq_mi,
 r.region,
 r.income_group;
```

1. Global situation:

1.1 forest area in 1990 and 2016

```
SELECT region, year, forest_area_sqkm
FROM forestation
WHERE country_name = 'World' AND (year = '1990' OR year = '2016');
```

1.2 forest area lost from 1990 to 2016

```
WITH t1
AS
(
    SELECT *
    FROM forestation
), t2
```

```
AS
(
    SELECT t1.forest_area_sqkm AS new_f, t1.country_code
    FROM t1
    WHERE t1.country_name = 'World' AND t1.year = '2016'
), t3
AS
(
    SELECT t1.forest_area_sqkm AS old_f, t1.country_code
    FROM t1
    WHERE t1.country_name = 'World' AND t1.year = '1990'
)
SELECT (old_f - new_f) AS forest_loss
FROM t2
JOIN t3
ON t2.country_code = t3.country_code;
```

1.3 forest area percentage lost from 1990 to 2016

```
WITH t1
AS
(
    SELECT *
    FROM forestation
), t2
AS
(
    SELECT t1.forest_area_sqkm AS new_f, t1.country_code
    FROM t1
    WHERE t1.country_name = 'World' AND t1.year = '2016'
), t3
AS
(
    SELECT t1.forest_area_sqkm AS old_f, t1.country_code
    FROM t1
    WHERE t1.country_name = 'World' AND t1.year = '1990'
)
SELECT ((old_f - new_f)/old_f)*100 AS loss
FROM t2
JOIN t3
ON t2.country_code = t3.country_code;
```

1.4 lost forest area similar to country in 2016

```
SELECT country_name, ROUND(CAST(total_area_sqkm AS numeric), 2) AS total_area_sqkm
FROM forestation
```

```
WHERE total_area_sqkm < (
    SELECT forest_area_sqkm AS old_f
    FROM forestation
    WHERE country_name = 'World' AND year = '1990')
    - (
    SELECT forest_area_sqkm AS new_f
    FROM forestation
    WHERE country_name = 'World' AND year = '2016')
AND year = '2016'
ORDER BY total_area_sqkm DESC
LIMIT 1;
```

2. Regional Outlook

2.1 forest area percent of world relative to land area in 2016 and 1990

```
SELECT country_name, ROUND(CAST(forest_percent AS numeric), 2) AS forest_percent, year
FROM forestation
WHERE country_name = 'World' AND (year = '1990' OR year = '2016');
```

2.2 highest and lowest forest percentage relative to land in 2016 and 1990

```
SELECT region, year,
ROUND(CAST(SUM(forest_area_sqkm) /SUM(total_area_sqkm) * 100 AS numeric), 2)
AS forest_percent
FROM forestation
WHERE (year = '2016' OR year = '1990')
AND region != 'World'
GROUP BY 1, 2
ORDER BY forest_percent DESC, year;
```

query: at top is highest at bottom is lowest

2.7 forest percentage values by region (Table 2.1: Percent Forest Area by Region, 1990 & 2016)

```
SELECT region, year, ROUND(CAST(SUM(forest_percent) AS NUMERIC), 2) AS forest_p
FROM (
  (SELECT region, f.year,
  ( Sum(f.forest_area_sqkm) / Sum(land.total_area_sq_mi * 2.59) ) * 100
  AS forest_percent
  FROM forest_area f
  INNER JOIN land_area land
  ON land.country_code = f.country_code
  AND land.year = f.year
  INNER JOIN regions r
  ON r.country_code = land.country_code
```

```
  WHERE f.year = '1990' OR f.year = '2016'
  GROUP BY region, f.year)
) as sub
GROUP BY region, year
ORDER BY region, year, forest_p;
```

3. COUNTRY-LEVEL DETAIL

3.1 A: largest growth in total_forest_area from 1990 to 2016

```
WITH t2 AS
(
    SELECT country_name, year y_16, country_code c_code,
    forest_area_sqkm f_area_16
    FROM forestation
    WHERE year = '2016'
), t3 AS
(
    SELECT country_name, year y_90, country_code c_code,
    forest_area_sqkm f_area_90
    FROM forestation
    WHERE year = '1990'
)
SELECT *, ROUND(CAST((t2.f_area_16 - t3.f_area_90) AS numeric), 2)
AS f_area_growth
FROM t3
JOIN t2
ON t2.c_code = t3.c_code AND t2.country_name = t3.country_name
WHERE t2.f_area_16 IS NOT NULL AND t3.f_area_90 IS NOT NULL
ORDER BY f_area_growth DESC
LIMIT 2;
```

3.2 A: largest growth in percent from 1990 to 2016 query: Iceland

```
WITH CTE
AS
(
    SELECT
    t1.country_name, t1.forest_percent_1990, t2.forest_percent_2016,
    ( t2.forest_percent_2016 - t1.forest_percent_1990 ) /
    t1.forest_percent_1990 * 100 AS forest_percent_increase
    FROM (SELECT
        country_name, forest_percent
        AS forest_percent_1990
        FROM forestation
        WHERE year = 1990
        AND forest_area_sqkm IS NOT NULL
```

```
        AND total_area_sq_mi IS NOT NULL
        GROUP BY 1, 2) t1
        JOIN (SELECT
            country_name, forest_percent
            AS forest_percent_2016
            FROM forestation
            WHERE year = 2016
            AND forest_area_sqkm IS NOT NULL
            AND total_area_sq_mi IS NOT NULL
            GROUP  BY 1, 2) t2
    ON t1.country_name = t2.country_name
    WHERE  t2.forest_percent_2016 > t1.forest_percent_1990
    ORDER BY 4 desc
)
SELECT country_name,
ROUND(CAST( forest_percent_increase AS NUMERIC), 2) AS forest_percent_increase
FROM CTE
LIMIT 1;
```

query: French Polynesia

```
WITH t2 AS
(
    SELECT country_name, year, country_code c_code, forest_percent
    FROM forestation
    WHERE year = '2016'
), t3 AS
(
    SELECT country_name, year, country_code c_code, forest_percent
    FROM forestation
    WHERE year = '1990'
), t4 AS
(
SELECT t2.country_name, t2.year y_16, t2.forest_percent f_percent_16,
t3.year y_90, t3.forest_percent f_percent_90
FROM t2
JOIN t3
ON t2.c_code = t3.c_code
)
SELECT *, ROUND(CAST((f_percent_16 - f_percent_90) AS numeric), 2)
AS f_percent_gained
FROM t4
GROUP BY country_name, y_16, y_90, f_percent_16, f_percent_90
HAVING f_percent_16 > f_percent_90 AND
f_percent_16 - f_percent_90 = MAX(f_percent_16 - f_percent_90)
ORDER BY f_percent_gained DESC
LIMIT 1;
```

Some reviewers say French Polynesia with 27.32% is correct. That is why I left this query in here too, also mentors on the knowledge platform recommended this.

3.3 B: Top 5 Amount Decrease in Forest Area by Country

```
WITH t1 AS
(
    SELECT country_code code_16, country_name, region, year y_16,
    ROUND(CAST(forest_area_sqkm AS NUMERIC), 2) AS f_area_16
    FROM forestation
    WHERE year = '2016'
    AND forest_area_sqkm IS NOT NULL
    AND country_name != 'World'
), t2 AS
(
    SELECT country_code code_90, country_name, region,
    ROUND(CAST(forest_area_sqkm AS NUMERIC), 2) AS f_area_90
    FROM forestation
    WHERE year = '1990'
    AND forest_area_sqkm IS NOT NULL
    AND country_name != 'World'
)
SELECT t1.country_name, t1.region, f_area_90 - f_area_16 AS f_area_lost,
f_area_90, f_area_16
FROM t1
JOIN t2
ON code_16 = code_90
ORDER BY f_area_lost DESC
LIMIT 5;
```

3.4 B: Top 5 Percent Decrease in Forest Area by Country

```
WITH t1 AS
(
    SELECT country_code, country_name, region, year y_16,
    (SUM(forest_area_sqkm) / SUM(total_area_sqkm) * 100)
    AS f_percent_16
    FROM forestation
    WHERE year = '2016'
    AND total_area_sqkm IS NOT NULL
    AND forest_area_sqkm IS NOT NULL
    GROUP BY 1, 2, 3, 4
), t2 AS
(
    SELECT country_code, country_name, region, year y_90,
```

```
    (SUM(forest_area_sqkm) / SUM(total_area_sqkm) * 100)
    AS f_percent_90
    FROM forestation
    WHERE year = '1990'
    AND total_area_sqkm IS NOT NULL
    AND forest_area_sqkm IS NOT NULL
    GROUP BY 1, 2, 3, 4
)
SELECT t1.country_name, t1.region, Round(Cast(( ( f_percent_90 -
f_percent_16 ) / f_percent_90 ) * 100 AS NUMERIC), 2) AS f_percent_decrease
FROM t1
JOIN t2
ON t1.country_code = t2.country_code AND t1.country_name = t2.country_name
WHERE f_percent_90 != 0
ORDER BY f_percent_decrease DESC
LIMIT 5;
```

3.5 C: If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
WITH t1 AS
(
    SELECT country_name, year,
    (forest_area_sqkm/ total_area_sqkm) AS
    f_percent_16
    FROM forestation
    WHERE year = 2016
    AND country_name != 'World'
    AND forest_area_sqkm IS NOT NULL
    AND total_area_sqkm IS NOT NULL
 )
SELECT
    Count( CASE
    WHEN t1.f_percent_16 < 0.25 THEN 1
    ELSE NULL
    END) AS quartile_1,
    Count( CASE
    WHEN t1.f_percent_16 > 0.25
    AND t1.f_percent_16 < 0.50 THEN 1
    ELSE NULL
    END) AS quartile_2,
    Count( CASE
    WHEN t1.f_percent_16 > 0.50
    AND t1.f_percent_16 < 0.75 THEN 1
    ELSE NULL
    END) AS quartile_3,
```

```
    Count( CASE
    WHEN t1.f_percent_16 > 0.75 THEN 1
    ELSE NULL
    END) AS quartile_4
FROM t1;
```

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

```
SELECT country_name, year, region,
ROUND(CAST((forest_area_sqkm/ total_area_sqkm) * 100 AS NUMERIC), 2) AS
f_percent_16
FROM forestation
WHERE year = 2016
AND country_name != 'World'
AND forest_area_sqkm IS NOT NULL
AND total_area_sqkm IS NOT NULL
AND (forest_area_sqkm/ total_area_sqkm) * 100 > 75
ORDER BY f_percent_16 DESC;
```

3.7 C: How many countries had a percent forestation higher than the United States in 2016?

```
WITH t1 AS
(
    SELECT country_name, year,
    (forest_area_sqkm/ total_area_sqkm) AS
    f_percent_16
    FROM forestation
    WHERE year = 2016
    AND country_name != 'World'
    AND forest_area_sqkm IS NOT NULL
    AND total_area_sqkm IS NOT NULL
    AND (forest_area_sqkm/ total_area_sqkm) >
        (SELECT (forest_area_sqkm/ total_area_sqkm)
         FROM forestation
         WHERE country_name = 'United States'
         AND year = 2016)
 )
SELECT
    COUNT(*) AS country_counter
FROM t1;
```