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 _ 15939264.4401544 sq mi__ in 1990. As of 2016, the most recent year for which data was available, that number had fallen to _ 15427894.1698842 sq mi_, a loss of __ -511370.270270271 sq mi__, or __-3.20824258980245____%.

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 _ 494208.49 sq mi_ _).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 31.3441787357731%_____. The region with the highest relative forestation was_ Latin America & Caribbean__, with ___46.16207_____%, and the region with the lowest relative forestation was __Middle East & North Africa_____, with ____2.068265_____% forestation.

In 1990, the percent of the total land area of the world designated as forest was __ 32.2111306265193%___. The region with the highest relative forestation was__ Latin America & Caribbean_____, with __51.02998_____%, and the region with the lowest relative forestation was __Middle East & North Africa_____, with ___1.775241_____% forestation.

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

Region	1990 Forest Percentage (%)	2016 Forest Percentage (%)
Latin America & Caribbean	51.0299798667511	46.1620721996045
Europe & Central Asia	37.2839398564018	38.0414216032515
North America	35.6511790009015	36.0393609681438
Sub-Saharan Africa	30.6741454610009	28.7881883550464
East Asia & Pacific	25.7760953973173	26.3586765000484
South Asia	16.510767001421	17.5058634081534
Middle East & North Africa	1.77524062469353	2.06826486871501

The only regions of the world that decreased in percent forest area from 1990 to 2016 were _ Sub-Saharan Africa _____ (dropped from ___30.67415_____% to __28.78819_____%) and __Latin America & Caribbean_____ (_51.02998_____% to ___46.16207_____%). 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 ___32.2111306265193%_____% to _31.3441787357731%_____%.

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 __203563.344401544 sq mi_____. 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 __30579.1505791508 sq mi____, much lower than the figure for __172984.193822394 sq mi_____.

__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 __213.664588870028_____% 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 (sq mi)
Brazil	Latin America & Caribbean	-209077.22007722
Indonesia	East Asia & Pacific	-108955.206332046
Myanmar	East Asia & Pacific	-41403.0903088803
Nigeria	Sub-Saharan Africa	-41122.0081003861
Tanzania	Sub-Saharan Africa	-39505.7915057915

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	-75.4452559270073
Nigeria	Sub-Saharan Africa	-61.7999309388418
Uganda	Sub-Saharan Africa	-59.1286034729531
Mauritania	Sub-Saharan Africa	-46.7469879518072
Honduras	Latin America & Caribbean	-45.0344149459194

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
75-over	9
75-50	38
50-25	72
25_under	85

The largest number of countries in 2016 were found in the ____25-under_____ 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	98.25769397
Micronesia, Fed. Sts.	East Asia & Pacific	91.85723907
Gabon	Sub-Saharan Africa	90.03764187
Seychelles	Sub-Saharan Africa	88.41113674
Palau	East Asia & Pacific	87.60680855
American Samoa	East Asia & Pacific	87.5000875
Guyana	Latin America & Caribbean	83.90144891
Lao PDR	East Asia & Pacific	82.10823176
Solomon Islands	East Asia & Pacific	77.86351779

4. RECOMMENDATIONS

- *What have you learned from the World Bank data?*

From the World Bank data, I learned that the total forest area had fallen 2.6% from 1990 to 2016. The total lost forest area is slightly more than the land area of Namibia.

As the data show the region with the lowest relative forestation was Middle East & North Africa in both 1990 and 2016.

Latin America & Caribbean had the highest relative forestation in 1990 and 2016. However, it was one of the regions that had decreased forest area from 1990 to 2016, such as Sub-Saharan Africa. All the other regions actually increased in forestation over this time period.

From the success stories and largest concerns in this data, I learned China had the largest increased forest area from 1990 to 2016. The increase of China's forest area was as large as Brazil forest area loss.

- *Which countries should we focus on over others?*

From the data, I think the top 5 percent decrease in forest area countries need the most attention than others. They were Togo, Nigeria, Uganda, Mauritania, and Honduras.

5. APPENDIX: SQL queries used

Part 1 /*Queries – used for Q1.Global Situation*/

1. /*create view 'forestation'*/

```
CREATE VIEW forestation
 AS
SELECT f.country_code, f.country_name, f.year, f.forest_area_sqkm, l.total_area_sq_mi,
r.region, r.income_group, (f.forest_area_sqkm/2.59) / (l.total_area_sq_mi)) * 100) AS Forest
FROM forest_area f
INNER JOIN land_area l ON f.country_code = l.country_code
AND f.year = l.year
INNER JOIN regions r ON r.country_code = f.country_code
```

2. / *total , loss and loss percent of forest area of the world in 1990&2016 */

```
WITH world_forest_2016 AS(
    SELECT country_code, forest_area_sqkm/2.59 forest_area
    FROM forest_area
```

```
    WHERE year = '2016'
      AND country_name = 'World'),

      world_forest_1990 AS(
    SELECT country_code, forest_area_sqkm/2.59 forest_area
    FROM forest_area
    WHERE year = '1990'
      AND country_name = 'World')

SELECT world_forest_1990.forest_area world_forest_1990, world_forest_2016.forest_area
world_forest_2016, world_forest_2016.forest_area-world_forest_1990.forest_area AS
loss_forest, (world_forest_2016.forest_area-
world_forest_1990.forest_area)/(world_forest_1990.forest_area)*100 AS loss_pect
  FROM world_forest_2016
  JOIN world_forest_1990
  ON world_forest_2016.country_code = world_forest_1990.country_code
```

3. /*The forest area total lost more than the entire land area in 2016*/

```
SELECT country_name,total_area_sq_mi
FROM land_area
WHERE total_area_sq_mi < (
   SELECT ( a.forest_area_sqkm/2.59-b.forest_area_sqkm/2.59 ) AS loss_sqmi
   FROM forestation a
   JOIN forestation b
   ON a.country_name=b.country_name
   WHERE a.year = 1990  AND b.year = 2016  AND a.country_name = 'World'  AND
b.country_name = 'World'
LIMIT 1)  AND year = 2016
GROUP BY 1,2
ORDER BY 2 DESC
LIMIT 1;
```

Part 2 /*Queries – used for Q2.Regional Outlook*/

1. /*% of the total land area of the world designated as forest in 2016*/

```
SELECT SUM(f.forest_area_sqkm/2.59)/SUM(l.total_area_sq_mi)*100 per_forest_2016
FROM land_area l
```

```
JOIN forest_area f
ON f.country_code = l.country_code
WHERE f.year = '2016' AND l.year = '2016'
```

2. /*% of the total land area of the world designated as forest in 1990*/

```
SELECT SUM(f.forest_area_sqkm/2.59)/SUM(l.total_area_sq_mi)*100 per_forest_1990
FROM land_area l
JOIN forest_area f
ON f.country_code = l.country_code
WHERE f.year = '1990' AND l.year = '1990'
```

3. /* Percent Forest Area by Region, 1990 & 2016*/

```
WITH forest_1990 AS
    (
    SELECT r.region,f.forest_area_sqkm/2.59 forest_area_sqmi
    FROM forest_area f
    JOIN regions r
    ON f.country_code=r.country_code
    WHERE f.year = '1990'),

    land_1990 AS
    (
    SELECT r.region, l.total_area_sq_mi
    FROM  land_area l
    JOIN regions r
    ON r.country_code=l.country_code
    WHERE year = '1990'
     )
SELECT forest_1990.region,
SUM(forest_1990.forest_area_sqmi)/SUM(land_1990.total_area_sq_mi)*100 forest_per_1990,
forest_per_2016,forest_per_2016-
SUM(forest_1990.forest_area_sqmi)/SUM(land_1990.total_area_sq_mi)*100 AS forest_change
FROM forest_1990
JOIN land_1990
ON forest_1990.region=land_1990.region

FULL JOIN
(
WITH forest_2016 AS
    (
    SELECT r.region,f.forest_area_sqkm/2.59 forest_area_sqmi
    FROM forest_area f
```

```
    JOIN regions r
    ON f.country_code=r.country_code
    WHERE f.year = '2016'),

    land_2016 AS
    (
    SELECT r.region region, l.total_area_sq_mi
    FROM  land_area l
    JOIN regions r
    ON r.country_code=l.country_code
    WHERE year = '2016'
     )
SELECT forest_2016.region region,
SUM(forest_2016.forest_area_sqmi)/SUM(land_2016.total_area_sq_mi)*100 as
forest_per_2016
FROM forest_2016
JOIN land_2016
ON forest_2016.region=land_2016.region
GROUP BY 1
ORDER BY 1
) t1
ON t1.region=forest_1990.region

GROUP BY 1,3
ORDER BY 2 DESC;
```

Part 3 /*Queries – used for Q3.Country-Level Detail*/

A.SUCCESS STORIES

1. /*forest changes by counties over 1990 to 2016* /

```
SELECT country_name,forest_change,LAG(forest_change) OVER (ORDER BY forest_change)
as lag_change,forest_change-LAG(forest_change) OVER (ORDER BY forest_change) as
lag_different
FROM (
    WITH forest_1990 AS (

      SELECT country_name,forest_area_sqkm/2.59 forest_area_sqmi
      FROM forest_area
     WHERE year = '1990'),
```

```
    forest_2016 AS (
    SELECT country_name,forest_area_sqkm/2.59 forest_area_sqmi
    FROM forest_area
    WHERE year = '2016')
  SELECT f1.country_name,f2.forest_area_sqmi - f1.forest_area_sqmi forest_change
  FROM forest_1990 f1
  JOIN forest_2016 f2
  ON f1.country_name=f2.country_name
  WHERE f2.forest_area_sqmi - f1.forest_area_sqmi IS NOT NULL
  GROUP BY 1,2
  ORDER BY 2 DESC
  ) t1
ORDER BY 2 DESC
LIMIT 10;
```

2. /*increased in forest area % from 1990 to 2016 by land rank*/

```
WITH forest_1990 AS (
  SELECT country_code, country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
  FROM forest_area
  WHERE year = '1990' ),
  forest_2016 AS (
  SELECT country_code, country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
  FROM forest_area
  WHERE year = '2016' )
SELECT forest_1990.country_name, (forest_2016.forest_area_sqmi-
forest_1990.forest_area_sqmi)/forest_1990.forest_area_sqmi*100 AS
forest_change_per,t1.land_area_sqmi , DENSE_RANK() OVER (ORDER BY
t1.land_area_sqmi DESC) AS land_rank
FROM forest_1990
JOIN forest_2016
ON forest_1990.country_code = forest_2016.country_code
JOIN (
   SELECT country_code,country_name,total_area_sq_mi land_area_sqmi
  FROM land_area
  WHERE total_area_sq_mi IS NOT NULL
      AND year = '2016'
  GROUP BY 1,2,3
  ORDER BY 3 DESC ) t1
ON t1.country_code = forest_1990.country_code
WHERE (forest_2016.forest_area_sqmi-
forest_1990.forest_area_sqmi)/forest_1990.forest_area_sqmi*100 IS NOT NULL
ORDER BY 2 DESC;
```

B.LARGEST CONCERNS

1. /*Top 5 Amount Decrease in Forest Area by Country, 1990 & 2016*/

```
WITH forest_1990 AS
        (
        SELECT country_code, country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
        FROM forest_area
        WHERE year = '1990' ),
       forest_2016 AS (
       SELECT country_code, country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
       FROM forest_area
       WHERE year = '2016' )
SELECT forest_1990.country_name country,r.region, forest_2016.forest_area_sqmi-
forest_1990.forest_area_sqmi forest_change
FROM forest_1990
JOIN forest_2016
ON forest_1990.country_code = forest_2016.country_code
JOIN regions r
ON r.country_code = forest_1990.country_code
WHERE forest_1990.country_name <> 'World'
GROUP BY 1,2,3
ORDER BY 3
LIMIT 5;
```

2. /*Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016*/

```
WITH forest_1990 AS (
    SELECT country_code, country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
    FROM forest_area
    WHERE year = '1990' ),
    forest_2016 AS (
    SELECT country_code, country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
    FROM forest_area
    WHERE year = '2016' )
SELECT forest_1990.country_name country,r.region, (forest_2016.forest_area_sqmi-
forest_1990.forest_area_sqmi)/forest_1990.forest_area_sqmi*100 forest_change_per
FROM forest_1990
JOIN forest_2016
ON forest_1990.country_code = forest_2016.country_code
JOIN regions r
ON r.country_code = forest_1990.country_code
WHERE forest_1990.country_name <> 'World'
GROUP BY 1,2,3
ORDER BY 3
```

```
LIMIT 5;
```

C.QUARTILES

1. /* Count of Countries Grouped by Forestation Percent Quartiles, 2016*/

```
SELECT quartile, COUNT(quartile) num_countries
FROM
  (
    WITH forest_area_sqmi AS
     (
      SELECT country_code,country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
      FROM forest_area
       WHERE year = '2016'
       )
SELECT l.country_name country_name,  f.forest_area_sqmi/l.total_area_sq_mi*100 AS
pect_forest,
     CASE WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 75 THEN '75_over'
          WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 50 AND
f.forest_area_sqmi/l.total_area_sq_mi*100 <= 75  THEN '75_50'
          WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 25 AND
f.forest_area_sqmi/l.total_area_sq_mi*100 <= 50  THEN '50_25'
          WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 0 AND
f.forest_area_sqmi/l.total_area_sq_mi*100 <= 25  THEN '25_under'
      END AS quartile
FROM land_area l
JOIN forest_area_sqmi f
ON f.country_code = l.country_code
WHERE l.year = '2016' AND f.forest_area_sqmi/l.total_area_sq_mi*100 <> 0 AND
l.country_name!='World'
GROUP By 1,2,3
ORDER BY 2 DESC ) t1

GROUP BY 1
ORDER BY 1 DESC
```

2. /* Top Quartile Countries, 2016*/

```
SELECT t1.country_name, r.region,t1.quartile
FROM
  (
    WITH forest_area_sqmi AS
```

```
    (
      SELECT country_code,country_name,year,forest_area_sqkm/2.59 forest_area_sqmi
      FROM forest_area
       WHERE year = '2016'
      )
    SELECT l.country_name country_name,  f.forest_area_sqmi/l.total_area_sq_mi*100 AS
pect_forest,
    CASE WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 75 THEN '75_over'
        WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 50 AND
f.forest_area_sqmi/l.total_area_sq_mi*100 <= 75  THEN '75_50'
        WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 25 AND
f.forest_area_sqmi/l.total_area_sq_mi*100 <= 50  THEN '50_25'
        WHEN f.forest_area_sqmi/l.total_area_sq_mi*100 > 0 AND
f.forest_area_sqmi/l.total_area_sq_mi*100 <= 25  THEN '25_under'
      END AS quartile
   FROM land_area l
   JOIN forest_area_sqmi f
   ON f.country_code = l.country_code
   WHERE l.year = '2016' AND f.forest_area_sqmi/l.total_area_sq_mi*100 <> 0
   GROUP By 1,2,3
   ORDER BY 2 DESC
    ) t1

JOIN regions r
ON r.country_name = t1.country_name
WHERE t1.quartile = '75_over'
ORDER BY 3 DESC
```