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 sq_km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.9 sq_km**, a loss of**1324449 sq_km**, or **-3.20824258980244 %.**

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 sq_km**).

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 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
Europe & Central Asia	37.28	38.04
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.51
Middle East & North Africa	1.78	2.07
World	32.42	31.38
North America	35.65	36.04

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 **527229.062 sq_km**. 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 sq_km**, 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 **343.9999962%** 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 and Caribbean	-541510
Indonesia	East Asia and Pacific	-282193.9844
Myanmar	East Asia and Pacific	-107234.0039
Nigeria	Sub-Saharan Africa	-106506.00098
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	-75.4452559270073
Nigeria	Sub-Saharan Africa	-61.7999309388418
Uganda	Sub-Saharan Africa	-59.1286034729531
Mauritania	Sub-Saharan Africa	-46.7469879518072
Hondurus	Latin America and Caribbean	-45.0344149459194

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 and 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	72
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
American Samoa	East Asia & Pacific	87.50
Micronesia, Fed. Sts.	East Asia & Pacific	91.86
Gabon	Sub-Saharan Africa	90.04
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.11
Palau	East Asia & Pacific	87.61
Solomon Islands	East Asia & Pacific	77.86
Suriname	Latin America & Caribbean	98.26
Seychelles	Sub-Saharan Africa	88.41

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?*

From the world bank data, it is clearly visible that the world has decreased total forest area from 1990 t0 2016. Though some of the regions of the world increased the forest area, that is not enough to impact the total forest area in the world. Mostly we can see that the sub-saharan area decreased the most in comparison to other parts of the world. The statistics showed that the most increase in total forest area was **China and the USA** but they are very large countries, so the percentage increase was low. On the other hand small countries like **Iceland** increased a good portion of their forest area. It is obvious to take measures in **Sub-saharan africa** area to develop and increase their forest percentage to bring impact also including **the middle east and north africa** area because this area has very low percentage of forest and increase is also very low. **Nigeria** is listed in the top five countries losing total forest area and also the percentage forest area. Extra measures should be taken for this country to recover its forest area. Another point is, the USA has 33.93 percent forest area and 94 countries have more forest percentage than the USA. Lastly, only nine countries are grouped into the quartile having more than 75 percent forest area. Important measures should be taken to increase the country number inside this quartile.

5. APPENDIX: SQL Queries Used

CREATING VIEW forestation:

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

In this view a column of total area with sq km has already been created for further use.

1. GLOBAL SITUATION

a.
```
SELECT  region, year,forest_area_sqkm
FROM forestation
WHERE region = 'World' AND
            year  = 1990 ;
```

Ans: 41282694.9

b.
```
SELECT  region, year,forest_area_sqkm
FROM forestation
WHERE region = 'World' AND
      year  = 2016 ;
```

Ans: 39958245.9

c.
```
SELECT f1.forest_area_sqkm - f2.forest_area_sqkm AS result
FROM forestation f1
JOIN forestation f2 ON f1.region = f2.region
WHERE f1.region = 'World'
      AND f1.year = 1990
      AND f2.year = 2016 ;
```

Ans : 1324449

d.
```
SELECT (f2.forest_area_sqkm - f1.forest_area_sqkm)*100/f1.forest_area_sqkm AS
pcnt_change_sqkm
FROM forestation f1
JOIN forestation f2 ON f1.region = f2.region
WHERE f1.region = 'World'
AND f1.year = 1990
AND f2.year = 2016 ;
```

Ans: -3.20824258980244

e.
```
SELECT country_name, year, (total_area_sq_mi * 2.59) AS total_area_sqkm
FROM forestation
WHERE year = 2016
ORDER BY total_area_sqkm ;
```

Ans: Peru

2. REGIONAL OUTLOOK

CREATING TABLE WITH percent forest area in 1990 and 2016

```
WITH
forest_percent_1990 AS
  (SELECT region,
(SUM(forest_area_sqkm) *100)/SUM(total_area_sq_km) AS
prcnt_forest_area_sqkm_1990
   FROM forestation
   WHERE year = 1990
   GROUP BY region),
 forest_percent_2016 AS
```

```
 (SELECT region,
 (SUM(forest_area_sqkm) *100)/SUM(total_area_sq_km) AS
prcnt_forest_area_sqkm_2016
 FROM forestation
 WHERE year = 2016
 GROUP BY region)
SELECT region,
      ROUND(CAST(prcnt_forest_area_sqkm_1990 AS NUMERIC), 2) AS forest_area_prct_1990 ,
       ROUND(CAST(prcnt_forest_area_sqkm_2016 AS NUMERIC),2) AS forest_area_prct_2016
  FROM forest_percent_1990
  JOIN forest_percent_2016
  USING (region) ;
```

3. COUNTRY LEVEL DETAIL

Finding out list of countries according to forest area increase in 2016 from 1990 from largest to smallest:

```
SELECT country_name, fr_90.region,
      fr_90.forest_area_sqkm AS forest_area_90,
      fr_16.forest_area_sqkm AS forest_area_16,
      (fr_16.forest_area_sqkm - fr_90.forest_area_sqkm)
        AS   Absolute_Forest_Area_Change


FROM
    (SELECT country_name, region, forest_area_sqkm
     FROM forestation
     WHERE year= 1990) AS fr_90
JOIN
   (SELECT country_name, region, forest_area_sqkm
     FROM forestation
     WHERE year= 2016) AS fr_16
USING(country_name)
ORDER BY Absolute_Forest_Area_Change DESC ;
```

Most increase in total forest area having CHINA
Secondly, The United States.

To find out percent forest area change of the countries:

```
SELECT country_name, fr_90.region,
      fr_90.forest_area_sqkm AS forest_area_90,
      fr_16.forest_area_sqkm AS forest_area_16,
      (fr_16.forest_area_sqkm - fr_90.forest_area_sqkm)  AS   Absolute_Forest_Area_Change,
      (fr_16.forest_area_sqkm - fr_90.forest_area_sqkm)*100/ fr_90.forest_area_sqkm  AS
       prct_forest_area_change
FROM
    (SELECT country_name, region, forest_area_sqkm
     FROM forestation
     WHERE year= 1990) AS fr_90
JOIN
   (SELECT country_name, region, forest_area_sqkm
     FROM forestation
     WHERE year= 2016) AS fr_16
USING(country_name)
ORDER BY prct_forest_area_change DESC ;
```

The country **ICELAND** showed the most increase in forest area percentage between 1990 and 2016 which is more than **343%.**

B.

The SQL query to find out absolute square kilometers decreased by countries, the above query was used to change the ORDER BY Absolute_Forest_Area_Change with ascending order and Five countries were found out which had the highest decrease in forest area.

In the same way ,percent Decrease in Forest Area by Country was achieved by the previous SQL query writing ORDER BY prct_forest_area_change with ascending order .

C. To find out the four quartile with country counts:

```
SELECT COUNT(country_name) AS country_count, quartile
 FROM
   (SELECT country_name,
    prcnt_forestation,
    CASE
        WHEN prcnt_forestation <= 25 THEN '1st quartile'
        WHEN prcnt_forestation <=50 THEN '2nd quartile'
        WHEN prcnt_forestation <=75 THEN '3rd quartile'
        WHEN prcnt_forestation >75 THEN '4th quartile'
        ELSE 'NULL'
     END AS quartile

    FROM (SELECT country_name, year,
         ROUND(CAST((forest_area_sqkm *100)/total_area_sq_km  AS   numeric), 2)
           AS prcnt_forestation
          FROM forestation )AS sam
         WHERE year = 2016 AND country_name != 'World'
                AND prcnt_forestation IS NOT NULL ) AS asif
 GROUP BY quartile ;
```

D. Country names and regions in 4th quartile:

```
SELECT country_name , region , prcnt_forestation
 FROM
   (SELECT country_name, region,
    prcnt_forestation,
    CASE
        WHEN prcnt_forestation <= 25 THEN '1st quartile'
        WHEN prcnt_forestation <=50 THEN '2nd quartile'
        WHEN prcnt_forestation <=75 THEN '3rd quartile'
        WHEN prcnt_forestation >75 THEN '4th quartile'
        ELSE 'NULL'
     END AS quartile

    FROM (SELECT country_name, year, region,
```

```
        ROUND(CAST((forest_area_sqkm *100)/total_area_sq_km  AS   numeric), 2)
         AS prcnt_forestation
        FROM
          (SELECT country_name, year, region, forest_area_sqkm,  total_area_sq_km
           FROM forestation )AS sam ) AS sky
        WHERE year = 2016 AND country_name != 'World'
        AND prcnt_forestation IS NOT NULL ) AS asif
WHERE quartile = '4th quartile'  ;
```

E. **Find out the forest percentage of United States :**

```
SELECT country_name , region , prcnt_forestation
 FROM
  (SELECT country_name, region,
   prcnt_forestation,
   CASE
       WHEN prcnt_forestation <= 25 THEN '1st quartile'
       WHEN prcnt_forestation <=50 THEN '2nd quartile'
       WHEN prcnt_forestation <=75 THEN '3rd quartile'
       WHEN prcnt_forestation >75 THEN '4th quartile'
       ELSE 'NULL'
    END AS quartile

    FROM (SELECT country_name, year, region,
                        ROUND(CAST((forest_area_sqkm *100)/total_area_sq_km  AS   numeric), 2)
                        AS prcnt_forestation
            FROM
              (SELECT country_name, year, region, forest_area_sqkm,  total_area_sq_km
               FROM forestation )AS sam ) AS sky
  WHERE year = 2016 AND country_name != 'World'
  AND prcnt_forestation IS NOT NULL ) AS asif
WHERE country_name= 'United States' ;
```

USA has 33.93 percent forest area

Using the above query, finding out how many countries have forest percentage more than USA:

```
 SELECT COUNT(country_name) AS country
FROM
   (SELECT country_name , region , prcnt_forestation
    FROM
     (SELECT country_name, region,
      prcnt_forestation,
      CASE
       WHEN prcnt_forestation <= 25 THEN '1st quartile'
       WHEN prcnt_forestation <=50 THEN '2nd quartile'
       WHEN prcnt_forestation <=75 THEN '3rd quartile'
       WHEN prcnt_forestation >75 THEN '4th quartile'
       ELSE 'NULL'
        END AS quartile

       FROM (SELECT country_name, year, region,
             ROUND(CAST((forest_area_sqkm *100)/total_area_sq_km   AS numeric), 2)
             AS prcnt_forestation
            FROM
             (SELECT country_name, year, region,   forest_area_sqkm, total_area_sq_km
              FROM forestation )AS sam ) AS sky
              WHERE year = 2016 AND country_name != 'World'
              AND prcnt_forestation IS NOT NULL ) AS asif )
               AS last_table
 WHERE prcnt_forestation > 33.93 ;
```

Ans: There are 94 countries having more percent forestation than the United States.