Report for Forest Query into Global Deforestation, 1990 to 2016

Forest Query 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 Forest Query 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 **4128269.90** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245.90** a loss of **1324449**, 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 **1279998.72 sqkm**).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was **31.37**. 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
Europe & Central Asia	37.28	38.04
North America	35.65	36.04
Sub-Saharan Africa	30.67	28.79
East Asia & Pacific	25.78	26.36
South Asia	16.51	17.51
Middle East & North Africa	1.78	2.07

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 **31.37**%.

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**. 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**, much lower than the figure for **Iceland**.

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
Indonesia	East Asia & Pacific	282194
Myanmar	East Asia & Pacific	107234
Nigeria	Sub-Saharan Arfica	106506
Tanzania	Sub-Saharan Arfica	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	-75.45
Nigeria	Sub-Saharan Africa	-61.80
Uganda	Sub-Saharan Africa	-59.13
Mauritania	Sub-Saharan Africa	-46.75
Honduras	Latin America	-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 Afric.** The countries are **Togo, Nigeria, Uganda,** and **Mauritania**. The 5th country on the list is **Hondura**, which is in the **Latin America** 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 1st quartile	85
25-50 2nd quartile	72
50-75 3rd quartile	38
75-100 4th quartile	9

The largest number of countries in 2016 were found in the **0-25 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 Armerica & Caribbean	98.26
Mocronesia, 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

5. RECOMMENDATIONS

For the period of 1990 – 2016 forest area has shrunk by 3.2%, (1324449 kmsq), although there is a shrinkage countries like China and United states have increased forest area over the same period, even though there is this increase the total forest area is still shrinking, countries in the region of Sub-Saharan Africa has been shrinking the fastest and should be a main focal point.

To conclude through what ever reasons be it Deforestation by humans, wild fires or climate change we need to act faster in replenishing the forest areas.

Appendix: SQL queries

```
/* explore the tables*/
SELECT * FROM forest_area;

SELECT * FROM land_area;

SELECT * FROM regions;

   /*
   create view forestation from 3 tables, All of the columns of the origin tables
   A new column that provides the percent of the land area that is designated as forest.
   1 sq mi = 2.59 sq km
   */
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation AS
SELECT f.country_code AS code,
      f.country_name AS country,
      r.region,
      r.income_group,
      cast(f.year AS int),
      cast(f.forest_area_sqkm AS int) AS forest_sqkm,
      cast(l.total_area_sq_mi AS int) AS land_sqmi, cast(100.0 * (f.forest_area_sqkm / (l.total_area_sq_mi * 2.59)) AS float(4)) AS
percentage
FROM forest_area f,
    land_area l,
    regions r
    /*  The forest_area and land_area tables join on both country_code AND year.
        The regions table joins these based on only country_code.
    */
WHERE (f.country_code = l.country_code
      AND f.year = l.year
      AND r.country_code = l.country_code);


SELECT *
FROM forestation;

--what was the total forest area in sq km of the world in 1990 and 2016 ?
SELECT *
FROM forestation
WHERE country = 'World'
   AND (YEAR = '2016'
        OR YEAR = '1990');
   --  2016 3995824
   --  1990 4128269

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

SELECT country,
      YEAR,
      forest_sqkm,
 cast(forest_sqkm - lag(forest_sqkm) over(
```

```
                                ORDER BY YEAR) AS int) AS sqkm_diff
FROM forestation
WHERE country = 'World'
  AND (YEAR = '2016'
       OR YEAR = '1990')
ORDER BY YEAR;-- difference of -1324449 in forest area between 1990 - 2016


--What was the percent change in forest area of the world between 1990 and 2016 ?

SELECT country,
     YEAR,
     forest_sqkm,
     lag(forest_sqkm) over(
                    ORDER BY YEAR) AS previous_sqkm,
     100.0 * forest_sqkm / lag(forest_sqkm) over(
                                    ORDER BY YEAR) -100 AS difference
FROM forestation
WHERE country = 'World'
  AND (YEAR = 2016
       OR YEAR = 1990)
ORDER BY YEAR; -- -3.2% decrease forest between 1990 - 2016

-- If you compare the amount of forest area lost between 1990 and 2016, to which country's total area in 2016 is it closest ?

SELECT country,
     land_sqmi * 2.59 AS total_area
FROM forestation
WHERE YEAR = 2016
ORDER BY total_area;-- Peru total forest / land 1279998.72 sqkm




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

-- what was the % of forest area in the world 2016
SELECT max(percentage)
FROM forestation
WHERE YEAR = 2016
  AND country = 'World'
GROUP BY region -- 31.37

-- what was the % of forest area in the world 1990
SELECT max(percentage)
FROM forestation
WHERE YEAR = 1990
  AND country = 'World';-- 32.42
```

```
-- Based on the table you created, which regions of the world DECREASED in forest area from 1990 to 2016?
https://knowledge.udacity.com/questions/408978

SELECT region,
     round(cast((forest_1990 / area_1990) * 100 AS NUMERIC),2) AS forest_percent_1990, -- calculate %, convert to numeric 2
decimals
     round(cast((forest_2016 / area_2016) * 100 AS NUMERIC),2) AS forest_percent_2016
FROM
  (SELECT yr90.region,
        sum(yr90.forest_sqkm) forest_1990,  -- sum up SQKM for 1990
        sum(yr90.land_sqmi * 2.59) area_1990,  -- sum up sqmi and convert to sqkm for 1990
        sum(yr16.forest_sqkm) forest_2016,
        sum(yr16.land_sqmi * 2.59) area_2016
   FROM forestation yr90,
       forestation yr16
   -- filter table
   WHERE yr90.year = '1990'
      AND yr90.country != 'World'
      AND yr16.year = '2016'
      AND yr16.country != 'World'
      AND yr90.region = yr16.region GROUP  BY yr90.region) AS calc_percent
      ORDER BY forest_percent_2016 DESC;


      /*
      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?
      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?
      */

--Country level Change of forest SQKM
SELECT yr90.country, yr90.region,
    (yr16.forest_sqkm - yr90.forest_sqkm) AS sqkm_change,
     round(cast((100.0 * (yr16.forest_sqkm - yr90.forest_sqkm) / yr90.forest_sqkm)AS numeric),2) AS percent_change

FROM forestation AS yr90
JOIN forestation AS yr16 ON (yr90.year = '1990'
                        AND yr16.year = '2016')
AND yr90.country = yr16.country
AND yr90.country != 'World'
ORDER BY sqkm_change DESC;

--Country level Change of forest SQKM %

SELECT yr90.country, yr90.region,
    abs(yr16.forest_sqkm - yr90.forest_sqkm) AS sqkm_change,
     round(cast((100.0 * (yr16.forest_sqkm - yr90.forest_sqkm) / yr90.forest_sqkm)AS numeric),2) AS percent_change

FROM forestation AS yr90
JOIN forestation AS yr16 ON (yr90.year = '1990'
                        AND yr16.year = '2016')
AND yr90.country = yr16.country
AND yr90.country != 'World'
ORDER BY percent_change;
```

```
--Country level Change of forest SQKM ABSOLUTE

SELECT yr90.country, yr90.region,
     abs(yr16.forest_sqkm - yr90.forest_sqkm) AS sqkm_change,
      round(cast((100.0 * (yr16.forest_sqkm - yr90.forest_sqkm) / yr90.forest_sqkm)AS numeric),2) AS percent_change

FROM forestation AS yr90
JOIN forestation AS yr16 ON (yr90.year = '1990'
                        AND yr16.year = '2016')
AND yr90.country = yr16.country
AND yr90.country != 'World'
ORDER BY sqkm_change Desc;



-- c. If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?
    https://www.w3schools.com/sql/sql_case.asp
https://knowledge.udacity.com/questions/340987
SELECT distinct(quartile), count(country) OVER (PARTITION BY quartile) AS country_count  --select distinct buckets from case
count countries in partions
FROM
   (SELECT country, region, CASE
         --Define quartile buckets
                  WHEN percentage <= 25 THEN '0-25% 1st quartile'
                  WHEN percentage <= 50 AND percentage > 25 THEN '25-50% 2nd quartile'
                  WHEN percentage <= 75 AND percentage > 50 THEN '50-75% 3rd quartile'
                  ELSE '75-100% 4th quartile'
               END AS quartile
    FROM forestation
    WHERE YEAR = 2016 AND country != 'World' and percentage IS NOT NULL) as qaurtiles

-- d. List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016
SELECT country, region, round(cast(percentage as numeric),2) --select country round percentage
FROM forestation
WHERE percentage > 75 and year = 2016 and country != 'world'
ORDER BY percentage desc;


-- e. How many countries had a percent forestation higher than the United States in 2016?
SELECT count(country)
FROM forestation
WHERE YEAR = '2016'
   AND percentage >
      (SELECT percentage
       FROM forestation
       WHERE YEAR = '2016'
          AND country = 'United States');  --94
```