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 41,282,694.9 km in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39,958,245.9 km, a loss of 1324449 km, or 3.21%.

The forest area lost over this time period is slightly less than the entire land area of Saudi Arabia listed for the year 2016 (which is 1335745.99 km).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 51.18%. The region with the highest relative forestation was Latin America and the Caribbean, with 77.77%, and the region with the lowest relative forestation was Middle East and North Africa, with 3.1% forestation.

In 1990, the percent of the total land area of the world designated as forest was 52.18%. The region with the highest relative forestation was Latin America and the Caribbean, with 82.13%, and the region with the lowest relative forestation was Middle East and North Africa, with 2.86% forestation.

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

Region	1990 Forest Percentage	2016 Forest Percentage
World	52.1788	51.1844
Latin America and Caribbean	82.1271	77.7650
Europe and Central Asia	60.0052	60.5632
North America	57.3754	57.5975
Sub-Saharan Africa	49.3318	47.5508
East Asia and Pacfic	41.1445	41.5519
South Asia	26.5716	27.1989
Middle East and North Africa	2.8569	3.0991

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Latin America and Caribbean (dropped from 82.13% to 77.77%) and Sub-Saharan Africa (49.33% to 47.55%). 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 52.18% to 51.18%.

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 527,229.06 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 79,200 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 68.12% 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	541,510 km
Indonesia	East Asia & Pacific	282,193.98 km
Myanmar	East Asia & Pacific	107,234 km
Nigeria	Sub-Saharan Africa	106,506 km
Tanzania	Sub-Saharan Africa	102,320 km

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	75.4452
Nigeria	Sub-Saharan Africa	61.7999
Uganda	Sub-Saharan Africa	59.1286
Mauritania	Sub-Saharan Africa	46.7469
Honduras	Latin America & Caribbean	45.0344

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 & 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
1	85
2	42
3	69
4	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	158.1315
Micronesia, Fed. Sts.	East Asia & Pacific	147.8309
Gabon	Sub-Saharan Africa	144.9025
Seychelles	Sub-Saharan Africa	142.2849
Palau	East Asia & Pacific	140.9904
American Samoa	East Asia & Pacific	140.8187
Guyana	Latin America & Caribbean	135.0272
Lao PDR	East Asia & Pacific	132.1413
Solomon Islands	East Asia & Pacific	125.3100

As of 2016 the United Stateshas a forestation percentage of 54.61%. There are 94 countries that have a percentage higher than this as of the 2016 data.

Table 3.5 Countries with Percentage Forestation Higher than the United States, 2016:

Country	Percentage Forest
Suriname	158.131549
Micronesia, Fed. Sts.	147.830943
Gabon	144.902564
Seychelles	142.284939
Palau	140.990489
American Samoa	140.818737
Guyana	135.027249
Lao PDR	132.141325
Solomon Islands	125.310072
Papua New Guinea	119.250652
Finland	117.655416
Bhutan	116.653402
Brunei Darussalam	116.044546
Marshall Islands	113.009376
Guinea-Bissau	112.288624
St. Vincent and the Grenadines	111.416283
Sweden	110.921493
Japan	110.170388
Malaysia	108.788601
Congo, Dem. Rep.	108.092483
Congo, Rep.	105.178797
Zambia	104.928607
Northern Mariana Islands	102.646676
Korea, Rep.	101.960453
Slovenia	99.7318212
Panama	99.5964656

Montenegro	98.9544205
Samoa	97.2440997
Belize	96.044862
Brazil	94.8410094
Peru	92.7961849
Dominica	92.3969573
Puerto Rico	90.5847673
Fiji	90.0305807
Sao Tome and Principe	89.8547934
Equatorial Guinea	89.2976756
Costa Rica	87.8179579
Latvia	86.8710312
Cayman Islands	85.1654828
Cambodia	85.0591516
Venezuela, RB	84.8760967
Colombia	84.8193667
Tanzania	83.0077099
Bahamas, The	82.7991077
Estonia	82.6187819
Bolivia	80.9283065
Ecuador	80.7992219
Grenada	80.4229653
Virgin Islands (U.S.)	80.4188917
Indonesia	80.2431001
Russian Federation	80.0792097
Gambia, The	77.8596425
Vietnam	77.3458036
Mozambique	77.223194
Austria	75.487965
Angola	74.5247588

Guam	74.5086979
Trinidad and Tobago	74.0681818
New Caledonia	73.8647825
Timor-Leste	73.0325161
Myanmar	70.2179479
Liechtenstein	69.3990279
Liberia	69.3232492
Sierra Leone	69.2883378
Senegal	68.8195213
Bosnia and Herzegovina	68.6804977
Belarus	68.60699
French Polynesia	68.1556362
St. Kitts and Nevis	68.0854677
Dominican Republic	67.1658496
Ghana	66.2400365
Korea, Dem. People‚Äôs Rep.	65.5450411
Georgia	65.3654308
Slovak Republic	64.9432335
Honduras	64.3224387
North Macedonia	63.6850501
Cameroon	63.3106416
New Zealand	62.0504292
Canada	61.4154908
Benin	60.8146793
Paraguay	60.7512416
Spain	59.443487
Turks and Caicos Islands	58.2748721
Vanuatu	58.0899859
Luxembourg	57.4204498
Central African Republic	57.2318588

Zimbabwe	57.2004468
Bulgaria	56.9293126
Lithuania	56.0584514
Portugal	55.7020749
Czech Republic	55.6250944
Croatia	55.2863562
Eswatini	55.2607426
Andorra	54.7857155

4. RECOMMENDATIONS

Write out a set of recommendations as an analyst on the ForestQuery team.

By analyzing the data regarding forestation, it has become apparent that, while the total sq km of forest area is important, it's not nearly as important as the percentages of increase or decrease in the forestation of a country or region. We should therefore be focused on assisting regions with the largest decrease in forest area percentage by studying the success of countries that have significantly increased their forest area. This overall will have a greater impact on the overall world forestation.

Focus should be spent on how the United States and China were able to increase their forest area over the course of 26 years. Once there is an understanding of how such a significant increase was gained then the regions of Latin America and Caribbean and Sub-Sarahan Africa should be the focus of applying our learnings. These two regions are significantly losing their forest area over the course and time and that loss is having a drastic effect on world forestation.

5. APPENDIX: SQL Queries

View:

```
CREATE VIEW forestation AS
SELECT reg.country_name
        ,f.year
        ,f.forest_area_sqkm
    ,lan.total_area_sq_mi
        ,f.forest_area_sqkm/(lan.total_area_sq_mi*1.60934) AS forest_per_land
FROM regions reg
JOIN land_area lan
ON reg.country_name=lan.country_name
```

```
JOIN forest_area f
ON lan.country_name=f.country_name AND lan.year=f.year
```

Question 1

Part 1

```
SELECT f.country_name
   ,f.forest_area_sqkm AS sqkm_2016
   ,f2.forest_area_sqkm AS sqkm_1990
   ,f2.forest_area_sqkm - f.forest_area_sqkm as diff_sqkm
   ,((f2.forest_area_sqkm - f.forest_area_sqkm)/f2.forest_area_sqkm)*100 AS percent_diff
FROM forest_area f
JOIN forest_area f2
ON f.country_name=f2.country_name AND f2.year=1990
WHERE f.country_code= 'WLD' AND f.year='2016'
```

Part 2

```
SELECT country_name
        ,year
        ,total_area_sq_mi *1.60934 AS total_area_sqkm
FROM land_area
WHERE year='2016' AND total_area_sq_mi *1.60934 >='1324449'
ORDER BY total_area_sq_mi *1.60934
LIMIT 1
```

Question 2

```
SELECT region
        , year
   ,(forest_area_sqkm/total_area_sqkm)*100 as percent_forest
FROM (SELECT r.region
                ,f.year
                ,SUM(f.forest_area_sqkm) OVER (region_year) as forest_area_sqkm
                ,SUM(l.total_area_sq_mi*1.60934) OVER (region_year) AS total_area_sqkm
        FROM regions r
        JOIN forest_area f
        ON r.country_name=f.country_name
        JOIN land_area l
        ON f.country_name=l.country_name AND f.year=l.year
```

```
   WINDOW region_year AS (PARTITION BY region ORDER BY f.year)) t1
WHERE year='2016' OR year='1990'
GROUP BY t1.region, t1.year, t1.forest_area_sqkm, t1.total_area_sqkm
ORDER BY year DESC
                    ,(forest_area_sqkm/total_area_sqkm)*100 DESC
```

Question 3

Part A.1

```
SELECT f.country_name
   ,f.forest_area_sqkm AS sqkm_1990
   ,f2.forest_area_sqkm AS sqkm_2016
   ,f2.forest_area_sqkm - f.forest_area_sqkm as diff_sqkm
   ,((f2.forest_area_sqkm - f.forest_area_sqkm)/f2.forest_area_sqkm)*100 AS percent_diff
FROM forest_area f
JOIN forest_area f2
ON f.country_name=f2.country_name AND f.year=1990 AND f2.year=2016
WHERE f.forest_area_sqkm IS NOT NULL AND f2.forest_area_sqkm  IS NOT NULL
ORDER BY f2.forest_area_sqkm - f.forest_area_sqkm DESC
LIMIT 2
```

Part A.2

```
SELECT f.country_name
   ,f.forest_area_sqkm AS sqkm_1990
   ,f2.forest_area_sqkm AS sqkm_2016
   ,f2.forest_area_sqkm - f.forest_area_sqkm as diff_sqkm
   ,((f2.forest_area_sqkm - f.forest_area_sqkm)/f2.forest_area_sqkm)*100 AS percent_diff
FROM forest_area f
JOIN forest_area f2
ON f.country_name=f2.country_name AND f.year=1990 AND f2.year=2016
WHERE f.forest_area_sqkm IS NOT NULL AND f2.forest_area_sqkm  IS NOT NULL
ORDER BY (f2.forest_area_sqkm / f.forest_area_sqkm)*100 DESC
LIMIT 1
```

Part B.1

```
SELECT f.country_name
         ,r.region
   ,f.forest_area_sqkm AS sqkm_2016
   ,f2.forest_area_sqkm AS sqkm_1990
   ,f2.forest_area_sqkm - f.forest_area_sqkm as diff_sqkm
```

```
   ,((f2.forest_area_sqkm - f.forest_area_sqkm)/f2.forest_area_sqkm)*100 AS percent_diff
FROM forest_area f
JOIN forest_area f2
ON f.country_name=f2.country_name AND f.year=2016 AND f2.year=1990
JOIN regions r
ON f.country_name=r.country_name
WHERE f.forest_area_sqkm IS NOT NULL AND f2.forest_area_sqkm  IS NOT NULL
ORDER BY f2.forest_area_sqkm - f.forest_area_sqkm DESC
LIMIT 6
```

Part B.2

```
SELECT f.country_name
          ,r.region
   ,f.forest_area_sqkm AS sqkm_2016
   ,f2.forest_area_sqkm AS sqkm_1990
   ,f2.forest_area_sqkm - f.forest_area_sqkm as diff_sqkm
   ,((f2.forest_area_sqkm - f.forest_area_sqkm)/f2.forest_area_sqkm)*100 AS percent_diff
FROM forest_area f
JOIN forest_area f2
ON f.country_name=f2.country_name AND f.year=2016 AND f2.year=1990
JOIN regions r
ON f.country_name=r.country_name
WHERE f.forest_area_sqkm IS NOT NULL AND f2.forest_area_sqkm  IS NOT NULL
ORDER BY (f2.forest_area_sqkm / f.forest_area_sqkm)*100 DESC
LIMIT 5
```

Part C.1

```
WITH t1 as
(SELECT l.country_name
                    ,f.forest_area_sqkm
                    ,l.total_area_sq_mi*1.60934 AS total_area_sqkm
                    , (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 as percent_forest
          FROM land_area l
          JOIN forest_area f
          ON l.country_name=f.country_name AND l.year=f.year
          WHERE l.year ='2016' AND l.total_area_sq_mi IS NOT NULL AND f.forest_area_sqkm
IS NOT NULL
   ORDER BY (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 DESC)
```

```
SELECT forest_quartile
      ,COUNT(country_name)
FROM (SELECT country_name
                  ,CASE
                        WHEN percent_forest <= 40 THEN 'Q1'
                  WHEN percent_forest <= 80 THEN 'Q2'
                  WHEN percent_forest <= 120 THEN 'Q3'
                  ELSE 'Q4' END AS forest_quartile
                  FROM t1)t2
GROUP BY t2.forest_quartile
```

Part C.2

```
WITH t1 as
        (SELECT l.country_name
                  ,f.forest_area_sqkm
                  ,l.total_area_sq_mi*1.60934 AS total_area_sqkm
                  , (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 as percent_forest
        FROM land_area l
        JOIN forest_area f
        ON l.country_name=f.country_name AND l.year=f.year
        WHERE l.year ='2016' AND l.total_area_sq_mi IS NOT NULL AND f.forest_area_sqkm
IS NOT NULL
   ORDER BY (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 DESC)

SELECT t1.country_name
      ,r.region
      ,t1.percent_forest
                  ,CASE
                  WHEN t1.percent_forest <= 40 THEN 'Q1''
                  WHEN t1.percent_forest <= 80 THEN 'Q2'
                  WHEN t1.percent_forest <= 120 THEN 'Q3'
                  ELSE 'Q4' END AS forest_quartile
FROM t1
JOIN regions r
ON t1.country_name=r.country_name
WHERE percent_forest > 120
```

US Question
Part 1

```
WITH t1 as
        (SELECT l.country_name
```

```
            ,f.forest_area_sqkm
            ,l.total_area_sq_mi*1.60934 AS total_area_sqkm
            , (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 as percent_forest
        FROM land_area l
        JOIN forest_area f
        ON l.country_name=f.country_name AND l.year=f.year
        WHERE l.year ='2016' AND l.total_area_sq_mi IS NOT NULL AND f.forest_area_sqkm
IS NOT NULL
   ORDER BY (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 DESC)

SELECT country_name
     ,percent_forest
FROM t1
WHERE t1.country_name='United States'
```

Part 2

```
WITH t1 as
        (SELECT l.country_name
            ,f.forest_area_sqkm
            ,l.total_area_sq_mi*1.60934 AS total_area_sqkm
            , (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 as percent_forest
        FROM land_area l
        JOIN forest_area f
        ON l.country_name=f.country_name AND l.year=f.year
        WHERE l.year ='2016' AND l.total_area_sq_mi IS NOT NULL AND f.forest_area_sqkm
IS NOT NULL
   ORDER BY (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 DESC)


SELECT COUNT(country_name)
     ,percent_us
FROM (SELECT country_name
        ,percent_forest
        , CASE
          WHEN percent_forest > 54.6051 THEN 'Higher'
           WHEN country_name = 'United States' THEN 'US'
          ELSE 'Not Higher' END AS percent_US
            FROM t1)t2
GROUP BY percent_US
```

Part 3

```
WITH t1 as
        (SELECT l.country_name
                ,f.forest_area_sqkm
                ,l.total_area_sq_mi*1.60934 AS total_area_sqkm
                , (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 as percent_forest
        FROM land_area l
        JOIN forest_area f
        ON l.country_name=f.country_name AND l.year=f.year
        WHERE l.year ='2016' AND l.total_area_sq_mi IS NOT NULL AND f.forest_area_sqkm
IS NOT NULL
   ORDER BY (f.forest_area_sqkm/(l.total_area_sq_mi*1.60934))*100 DESC)


SELECT country_name
      ,percent_us
FROM (SELECT country_name
        ,percent_forest
        , CASE
          WHEN percent_forest > 54.6051 THEN 'Higher'
                WHEN country_name = 'United States' THEN 'US'
          ELSE 'Not Higher' END AS percent_US
                FROM t1)t2
WHERE percent_US = 'Higher'
```