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 3.21 %.

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 sqkm).

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
Latin America & Caribbean	51.03	46.16
Sub-Saharan Africa	30.67	28.79

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 sqkm, much lower than the figure for China.

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	541510.00
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	59.13%
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
First	85
Second	72
Third	38
Fourth	9

The largest number of countries in 2016 were found in the first 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	98.25
Micronesia, Fed. Sts.	East Asia & Pacific	91.85
Gabon	Sub-Saharan Africa	90.03
Seychelles	Sub-Saharan Africa	88.41
Palau	East Asia & Pacific	87.60
American Samoa	East Asia & Pacific	87.50
Guyana	Latin America & Caribbean	83.90
Lao PDR	East Asia & Pacific	82.10
Solomon Islands	East Asia & Pacific	77.86

5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
  We have learned that deforestation is happening all over the world in many regions for various different reasons. Many regions have increased in forest area like East Asia and the pacific, North America, Central Asia, Middle east and North Africa. However, Latin America & Caribbean and Sub-Saharan Africa have lost most forest area from 1990 to

2016. We have seen that China and United States has increased on forest area for a large country and for smaller country Iceland has increased of 213.66% on forest area.

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

  Countries in Sub-Saharan Africa (Togo (75.45%), Nigeria (61.80%), Uganda (59.13%), Mauritania (46.75%)) which we have seen on both table which decreased both by absolute forest area and percent of forest area change. By forest land area decreased Latin America & Caribbean (Brazil) and East Asia and Pacific (Myanmar, Indonesia) countries needs focus as well.
  Very first thing we can do is look at successful countries like China, USA, and Iceland to see what worked in their country. Then we must make sure we decrease the footprint of using too much wood product. Which we can achieve by creating awareness among citizens and communities by working together NGO/Non-Profit and also with government and also create strict laws about deforestation.

CODE Appendix

Creating View Called Forestation:

```
DROP VIEW IF EXISTS forestation;

CREATE VIEW forestation
AS
  SELECT fa.country_code,
         fa.country_name,
         fa.year,
         fa.forest_area_sqkm,
         la.total_area_sq_mi,
         r.region,
         r.income_group,
         ( ( Sum(fa.forest_area_sqkm) / Sum(la.total_area_sq_mi * 2.59
) ) * 100
         )
            AS
         forest_percentage
  FROM   forest_area AS fa
         JOIN land_area AS la
           ON fa.country_code = la.country_code
              AND fa.year = la.year
         JOIN regions AS r
           ON r.country_code = fa.country_code
  GROUP  BY fa.country_code,
            fa.country_name,
            fa.year,
            fa.forest_area_sqkm,
            la.total_area_sq_mi,
            r.region,
            r.income_group
```

Global Situation

1. a) What was the total forest area (in sq km) of the world in 1990?

```
SELECT Sum(forest_area_sqkm) AS forest_area_in_sq_KM
FROM   forestation
WHERE  year = '1990'
       AND region = 'World'
```

Result: 41282694.9

1. b) What was the total forest area (in sq km) of the world in 2016?

```
SELECT Sum(forest_area_sqkm) AS forest_area_in_sq_KM
FROM   forestation
WHERE  year = '2016'
       AND region = 'World'
```

Result: 39958245.9

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

```
SELECT ( (SELECT Sum(forest_area_sqkm) AS forest_area_in_sq_KM
          FROM   forestation
          WHERE  year = '1990'
                 AND region = 'World') - (SELECT
                Sum(forest_area_sqkm) AS forest_area_in_sq_KM
                                         FROM   forestation
                                         WHERE  year = '2016'
                                                AND region = 'Wo
rld') ) AS
       forest_area_chnage
FROM   forestation
LIMIT  1
```

Result: 1324449

1. d) What was the percent change in forest area of the world between 1990 and 2016?

```
SELECT Round(( ( (SELECT Sum(forest_area_sqkm) AS forest_area_in_
sq_KM
                  FROM   forestation
                  WHERE  year = '1990'
                         AND region = 'World') - (SELECT
                 Sum(forest_area_sqkm) AS
                 forest_area_in_sq_KM
                                                  FROM   forestat
ion
                                                  WHERE  year = '
2016'
                                                         AND regi
on = 'World') )
                * 100
                      / (
                          SELECT Sum(forest_area_sqkm) AS fores
t_area_in_sq_KM
                          FROM
                            forestation
                          WHERE
                            year = '1990'
                            AND region = 'World') ) :: NUMERIC,
 2) AS
       forest_percentage_chnage
```

```
FROM   forestation
LIMIT  1
```
Result: 3.21%

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

```
SELECT country_name,
       Sum(total_area_sq_mi) * 2.59 AS total_area_sqkm
FROM   forestation
WHERE  year = '2016'
       AND total_area_sq_mi IS NOT NULL
GROUP  BY 1
HAVING Sum(total_area_sq_mi) * 2.59 < 1330000
       AND Sum(total_area_sq_mi) * 2.59 > 1270000
ORDER  BY 2 DESC
```

RESULT: Peru -- 1279999.9891

REGIONAL OUTLOOK

2. 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?

```
SELECT country_name,
       Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2
.59) ) * 100 )
             ::
             NUMERIC, 2) AS forest_percentage
FROM   forestation
WHERE  year = '2016'
       AND region = 'World'
GROUP  BY country_name
```

Result: 31.38 %

```
SELECT region,
       Round(( ( Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2
.59) ) * 100 )
             ::
             NUMERIC, 2) AS forest_percentage
FROM   forestation
WHERE  year = '2016'
GROUP  BY 1
ORDER  BY 2 DESC
LIMIT  1
```

Result: Latin America & Caribbean 46.16 %

```
SELECT region,
       Round(( ( Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2
.59) ) * 100 )
                ::
              NUMERIC, 2) AS forest_percentage
FROM   forestation
WHERE  year = '2016'
GROUP  BY 1
ORDER  BY 2
LIMIT  1
```

Result: Middle East & North Africa 2.07 %

2. 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?

```
SELECT country_name,
       Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi * 2.59)
) * 100 )
              ::
              NUMERIC, 2) AS forest_percentage
FROM   forestation
WHERE  year = '1990'
       AND region = 'World'
GROUP  BY country_name
```

Result: 32.42 %

```
SELECT region,
       Round(( ( Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2.59)
) * 100 )
              ::
              NUMERIC, 2) AS forest_percentage
FROM   forestation
WHERE  year = '1990'
GROUP  BY 1
ORDER  BY 2 DESC
LIMIT  1
```

Result: Latin America & Caribbean 51.03%

```
SELECT region,
       Round(( ( Sum(forest_area_sqkm) / Sum(total_area_sq_mi * 2.59)
) * 100 )
              ::
              NUMERIC, 2) AS forest_percentage
FROM   forestation
```

```
WHERE  year = '1990'
GROUP  BY 1
ORDER  BY 2
LIMIT  1
```

Result: Middle East & North Africa 1.78 %

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

```
WITH forest_percentage_1990
     AS (SELECT region,
                Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi
 * 2.59) )
                        *
                        100 )
                       ::
                       NUMERIC, 2) AS forest_percentage
         FROM   forestation
         WHERE  year = '1990'
         GROUP  BY 1
         ORDER  BY 2 DESC),
     forest_percentage_2016
     AS (SELECT region,
                Round(( ( SUM(forest_area_sqkm) / SUM(total_area_sq_mi
 * 2.59) )
                        *
                        100 )
                       ::
                       NUMERIC, 2) AS forest_percentage
         FROM   forestation
         WHERE  year = '2016'
         GROUP  BY 1
         ORDER  BY 2 DESC)
SELECT forest_percentage_1990.region,
       forest_percentage_1990.forest_percentage AS forest_percentage_1
990,
       forest_percentage_2016.forest_percentage AS forest_percentage_2
016
FROM   forest_percentage_1990
       join forest_percentage_2016
         ON forest_percentage_1990.region = forest_percentage_2016.reg
ion
```

Country Level Detail:

3. 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?

```
WITH fa_1990 AS
(
       SELECT region,
              country_name,
              forest_area_sqkm
       FROM   forestation
       WHERE  year = '1990'), fa_2016 AS
(
       SELECT region,
              country_name,
              forest_area_sqkm
       FROM   forestation
       WHERE  year = '2016')
SELECT   fa_1990.region,
         fa_1990.country_name,
         fa_1990.forest_area_sqkm
                  AS forest_area_1990,
         fa_2016.forest_area_sqkm
                  AS forest_area_2016,
         Round(Cast((fa_1990.forest_area_sqkm - fa_2016.forest_area_sq
km) AS NUMERIC),2) AS area_decresed_by_sqkm
FROM     fa_1990
JOIN     fa_2016
ON       fa_1990.country_name = fa_2016.country_name
WHERE    fa_2016.forest_area_sqkm < fa_1990.forest_area_sqkm
AND      fa_1990.region NOT LIKE 'World'
ORDER BY area_decresed_by_sqkm DESC limit 5
```

3. 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?

```
WITH fa_1990 AS
(
```

```
       SELECT region,
              country_name,
              forest_area_sqkm
       FROM   forestation
       WHERE  year = '1990'), fa_2016 AS
(
       SELECT region,
              country_name,
              forest_area_sqkm
       FROM   forestation
       WHERE  year = '2016')
SELECT   fa_1990.region,
         fa_1990.country_name,
         fa_1990.forest_area_sqkm
                  AS forest_area_1990,
         fa_2016.forest_area_sqkm
                  AS forest_area_2016,
         Round(Cast((fa_1990.forest_area_sqkm - fa_2016.forest_area_sq
km) AS                                   NUMERIC),2) AS area_decresed_by_
sqkm,
         Round(Cast(((fa_1990.forest_area_sqkm - fa_2016.forest_area_s
qkm)*100/fa_1990.forest_area_sqkm) AS NUMERIC),2) AS area_decresed_by_
percent
FROM     fa_1990
JOIN     fa_2016
ON       fa_1990.country_name = fa_2016.country_name
WHERE    fa_2016.forest_area_sqkm < fa_1990.forest_area_sqkm
AND      fa_1990.region NOT LIKE 'World'
ORDER BY area_decresed_by_percent DESC limit 5
```

3. c. If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?

```
WITH fs_2016
     AS (SELECT *
         FROM   forestation
         WHERE  year = '2016'
                AND region NOT LIKE 'World'
                AND forest_percentage IS NOT NULL),
     fs_group
     AS (SELECT *,
                CASE
                  WHEN forest_percentage > 75 THEN 'Fourth'
                  WHEN forest_percentage <= 75
                       AND forest_percentage > 50 THEN 'Third'
                  WHEN forest_percentage <= 50
                       AND forest_percentage > 25 THEN 'Second'
                  ELSE 'First'
                END AS quartiles
         FROM   fs_2016)
SELECT quartiles,
       Count(*) AS quartile_group
```

```
FROM   fs_group
GROUP  BY 1
```

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

```
WITH fs_group
     AS (SELECT country_name,
                CASE
                  WHEN forest_percentage > 75 THEN 'Fourth'
                  WHEN forest_percentage <= 75
                       AND forest_percentage > 50 THEN 'Third'
                  WHEN forest_percentage <= 50
                       AND forest_percentage > 25 THEN 'Second'
                  ELSE 'First'
                END AS quartiles
         FROM   forestation
         WHERE  year = '2016'
                AND region NOT LIKE 'World'
                AND forest_percentage IS NOT NULL)
SELECT DISTINCT( quartiles ),
               country_name
FROM   fs_group
WHERE  quartiles = 'Fourth'
```

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

```
SELECT Count(country_name)
FROM   forestation
WHERE  year = '2016'
       AND forest_percentage > (SELECT forest_percentage
                                FROM   forestation
                                WHERE  country_name = 'United States'
                                       AND year = '2016')
```

Result: 91

Table 3.4: Top Quartile Countries, 2016:

```
SELECT country_name,
       region,
       forest_percentage
FROM   forestation
WHERE  year = '2016'
       AND forest_percentage > 75
       AND forest_percentage IS NOT NULL
ORDER  BY forest_percentage DESC;
```