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 km^2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 39958245.9 km^2, a loss of 1324449.0km^2, or -3.23%.

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 1279999.9891km^2).

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	forest_per_1990	forest_per_2016	percent_diff
Latin America & Caribbean	51.03	46.16	-4.87
Sub-Saharan Africa	30.67	28.79	-1.88
World	32.42	31.38	-1.05
Middle East & North Africa	1.78	2.07	0.29
North America	35.65	36.04	0.39
East Asia & Pacific	25.78	26.36	0.58
Europe & Central Asia	37.28	38.04	0.76
South Asia	16.51	17.51	1.00

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 527229km^2. 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 79200km^2, 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
Indonesia	East Asia & Pacific	-282194
Myanmar	East Asia & Pacific	-107234
Nigeria	Sub-Saharan Africa	-106506
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	-75.45
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
1	85
2	72
3	38
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	98.26
Micronesia, 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	East Asia & Pacific	77.86

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?*

We gathered information through data from the World Bank (from 1990 to 2016) and analysed the trend in the forest area around the globe.

The general trend is negative, and deforestation has progressed. The total area of forest has decreased by 3.23% or 1324449.0km^2. The area comparable to an entire country of Peru has disappeared over the quarter of the century.

If we look into the regional change (Table 2.1), we see a more precise picture of what is going on. Deforestation in the world primarily happens in two regions, Latin America & Caribbean and Sub-Saharan Africa. Although other regions have shown a positive trend, the impact of those two outweighs the rest. It is also worth noting that Latin America & Caribbean has been the region with the highest relative forestation, and deforestation is happening fast there.

Next, we focus on the country-wise trend. One country stood out positively, and that is China. This country managed to increase the forest area by 527229km^2, and this is by far the most substantial increase (almost seven times more than the United States, who came second). On the flip side, there is severe deforestation taking place in Brazil and Indonesia (Table 3.1). The forest area lost in these countries is 541510km^2 and 282194km^2, respectively. This is 5.5 or 3 times larger than the Myanmar who came the third in the list. We also consider deforestation in terms of percent decrease (Table 3.2). Top four countries are from Sub-Saharan Africa, and then Honduras from Latin America & Caribbean region took 5th place. This is in line with the observation made regionally, and indicating the serious effort needed in these regions. Nigeria is the only country placed in both rankings, and success to stop the deforestation there might become a useful model case.
Grouping all the countries into quartiles in terms of the percentage of forest area in each country, we found that 85 countries have less than 25% of forest area, this is by far the biggest group (Table 3.3). Only nine countries have more than 75% forest area, and these are summarised in Table 3.4. While it is vital to increase the forest area in the countries in the first quartile, it is essential that these nine countries maintain their figure.

Based on these facts, we would recommend the following actions

- The primary focus should be on Latin America & Caribbean and Sub-Saharan Africa
- Fast action is needed in Brazil and Indonesia
- Success case in Nigeria can become the model case to lead the other nations
- Worth noting the success of China and the US, and finding out what factor contributed to their success

5. Appendix: SQL Queries used:

Creating forestation view

```
---------------------------------------------------------------------------

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

Part 1

a), b)

```
-----------------------------------------------------------------------------
SELECT  country_name,
        forest_area_sqkm
FROM    forestation
WHERE   country_name = 'World'
  AND   year = 1990  --change to 2016 for b)
-----------------------------------------------------------------------------
```

c) & d)

```
-----------------------------------------------------------------------------
SELECT  t2.forest_area_sqkm - t1.forest_area_sqkm AS forest_area_sqkm_diff,
        (t2.forest_area_per - t1.forest_area_per)/t1.forest_area_per * 100
        AS forest_area_per_diff
FROM    (
        SELECT  country_name,
                forest_area_sqkm,
                forest_area_per
        FROM    forestation
        WHERE   country_name = 'World'
          AND   year = 1990) AS t1
```

```
  JOIN  (
      SELECT  country_name,
              forest_area_sqkm,
              forest_area_per
      FROM    forestation
      WHERE   country_name = 'World'
        AND   year = 2016) AS t2
  ON    t1.country_name = t2.country_name
-------------------------------------------------------------------------
e)
-------------------------------------------------------------------------
SELECT  country_name,
       land_area_sqkm
FROM    forestation
WHERE   year = 2016
   AND land_area_sqkm <
   (SELECT  -(t2.forest_area_sqkm - t1.forest_area_sqkm) AS forest_area_sqkm_diff
   FROM    (
          SELECT  country_name,
                  forest_area_sqkm,
                  forest_area_per
          FROM    forestation
          WHERE   country_name = 'World'
            AND   year = 1990) AS t1
     JOIN  (
          SELECT  country_name,
                  forest_area_sqkm,
                  forest_area_per
          FROM    forestation
          WHERE   country_name = 'World'
            AND   year = 2016) AS t2
     ON    t1.country_name = t2.country_name
   )
ORDER BY 2 DESC
-------------------------------------------------------------------------
```

Part 2

```
a), b)
-------------------------------------------------------------------------
WITH  tab_1990 AS (
              SELECT  region,
                      SUM(forest_area_sqkm)/SUM(land_area_sqkm) * 100 AS forest_per_region
              FROM    forestation
              WHERE   year = 1990
```

```
            AND   forest_area_per IS NOT NULL -- eliminating null entries in either forest or
land area
            GROUP BY 1),
    tab_2016 AS (
            SELECT  region,
                  SUM(forest_area_sqkm)/SUM(land_area_sqkm) * 100 AS forest_per_region
            FROM    forestation
            WHERE   year = 2016
             AND   forest_area_per IS NOT NULL
            GROUP BY 1
            )

SELECT  region,
      forest_per_region
FROM    tab_2016 -- change to tab_1990 for question b
ORDER BY 2 DESC -- Change to ASC to find the region with min forest percentage


c)
--------------------------------------------------------------------------------
WITH  tab_1990 AS (
            SELECT  region,
                  ROUND(CAST(SUM(forest_area_sqkm)/SUM(land_area_sqkm)*100 AS
NUMERIC),2) AS forest_per_region
            FROM    forestation
            WHERE   year = 1990
            GROUP BY 1),
    tab_2016 AS (
            SELECT  region,
                  ROUND(CAST(SUM(forest_area_sqkm)/SUM(land_area_sqkm)*100 AS
NUMERIC),2) AS forest_per_region
            FROM    forestation
            WHERE   year = 2016
            GROUP BY 1
            )
SELECT  tab_1990.region,
      tab_1990.forest_per_region AS forest_per_region_1990,
      tab_2016.forest_per_region AS forest_per_region_2016,
      tab_2016.forest_per_region - tab_1990.forest_per_region AS percent_diff
FROM    tab_1990
 JOIN  tab_2016
 ON    tab_1990.region = tab_2016.region
ORDER BY 4
--------------------------------------------------------------------------------
```

Part 3

a), b)

```
WITH  tab_1990 AS (
            SELECT  country_name,
                  region,
                  forest_area_sqkm,
                  forest_area_per
            FROM    forestation
            WHERE   year = 1990
              AND   forest_area_per IS NOT NULL),
     tab_2016 AS (
            SELECT  country_name,
                  region,
                  forest_area_sqkm,
                  forest_area_per
            FROM    forestation
            WHERE   year = 2016
              AND   forest_area_per IS NOT NULL)

SELECT  tab_1990.country_name,
       tab_1990.region,
       tab_1990.forest_area_sqkm AS forest_area_sqkm_1990,
       tab_2016.forest_area_sqkm AS forest_area_sqkm_2016,
       tab_2016.forest_area_sqkm - tab_1990.forest_area_sqkm
       AS sqkm_change_in_forest_area,
       ROUND(CAST((tab_2016.forest_area_sqkm - tab_1990.forest_area_sqkm)
       /tab_1990.forest_area_sqkm*100 AS NUMERIC),2) AS perc_change_in_forest_area
FROM    tab_1990
  JOIN  tab_2016
  ON    tab_1990.country_name = tab_2016.country_name
ORDER BY  5  -- change to 6 to see percent decrease
           -- Change to DESC to see countries doing well
LIMIT 6 -- 'World' has the largest lost land.  Set to 6 to see top 5 countries
```

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c)

```
SELECT  quartile,
       COUNT(*)
FROM    (
       SELECT  country_name,
              region,
              forest_area_per,
              CASE
```

```
            WHEN  forest_area_per> 75 THEN 4
            WHEN  forest_area_per> 50 THEN 3
            WHEN  forest_area_per> 25 THEN 2
            ELSE  1
          END AS quartile
    FROM    tab_2016
    WHERE   country_name != 'World'
    ) AS tab_qt
GROUP BY 1
ORDER BY 1
--------------------------------------------------------------------------
d).
--------------------------------------------------------------------------
SELECT  country_name,
    region,
    forest_area_per
FROM    (
    SELECT  country_name,
          region,
          forest_area_per,
          CASE
            WHEN  forest_area_per> 75 THEN 4
            WHEN  forest_area_per> 50 THEN 3
            WHEN  forest_area_per>25 THEN 2
            ELSE  1
          END AS quartile
    FROM    tab_2016
    ) AS tab_qt
WHERE   quartile = 4
ORDER BY 3 DESC
-----------------------------------------------------------------
e)
-----------------------------------------------------------------
SELECT  COUNT(*)
FROM    tab_2016
WHERE   forest_area_per > (
                SELECT  forest_area_per
                FROM    tab_2016
                WHERE   country_name = 'United States'
                )
-----------------------------------------------------------------
```