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 82.016.472,04 Km^2 in 1990. As of 2016, the most recent year for which data was available, that number had fallen to 79.825.433,95 Km^2, a loss of 2.191.038,09 Km^2, or 2.67%.

The forest area lost over this time period is slightly more than the entire land area of Saudi Arabia listed for the year 2016 (which is 2.149.690,00Km^2).

2. **REGIONAL OUTLOOK**

In 2016, the percent of the total land area of the world designated as forest was 31.34% 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 32.21%. 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
Middle East & North Africa	1.78	2.07
South Asia	16.51	17.51
East Asia & Pacific	25.78	26.36
Sub-Saharan Africa	30.67	28.79
World	32.42	31.38
North America	35.65	36.04
Europe & Central Asia	37.28	38.04
Latin America & Caribbean	51.03	46.16

The only regions of the world that decreased in percent forest area from 1990 to 2016 were Sub-Saharan Africa, and Latin America & Caribbean (dropped from 30.67% to 28.79% and 51.03% to 46.16% respectively). 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 32.21%. to 31.34%.

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 527.229,06Km^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 79.200Km^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. French Polynesia increased in forest area by 27.32% 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	-1.324.449 km^2
Indonesia	East Asia & Pacific	-541.510 km^2
Myanmar	East Asia & Pacific	-282.193.98 Km^2
Nigeria	Sub-Saharan Africa	-107.234 Km^2
Tanzania	Sub-Saharan Africa	-106.506 Km^2

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
Honduras	Latin America & Caribbean	-32.75
Korea, Dem. People's Rep.	East Asia & Pacific	-27.38
Zimbabwe	Sub-Saharan Africa	-21.75
Cambodia	East Asia & Pacific	-20.48
Timor-Leste	East Asia & Pacific	-19.58

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 East Asia & Pacific. The countries are Honduras,Korea, Dem. People's Rep., Cambodia, and Timor-Leste. The 5th country on the list is Zimbabwe, which is in the Sub-Saharan Africa region.

From the above analysis, we see that _____ 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	52
2	51
3	51
4	51

The largest number of countries in 2016 were found in the 1st quartile.

There were 52 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	4
Micronesia, Fed. Sts.	East Asia & Pacific	4
Gabon	Sub-Saharan Africa	4

5. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*
  A: The global forestation area over the world has decrease, the most affected regions were the Latin America & Caribbean, Sub-Saharan Africa and Sub-Saharan Africa countries.
- *Which countries should we focus on over others?*
  A: We must focus on the countries on more devastated regions, referencing Brazil, Indonesia, Myanmar, Nigeria and lastlyTanzania.

Appendix

Steps to Complete

Create a View called “forestation” by joining all three tables - forest_area, land_area and regions in the workspace.
The forest_area and land_area tables join on both country_code AND year.
The regions table joins these based on only country_code.
In the ‘forestation’ View, include the following:
All of the columns of the origin tables
A new column that provides the percent of the land area that is designated as forest.

```
CREATE VIEW forestation AS
(SELECT fa.country_code,
fa.country_name,
fa.year,
fa.forest_area_sqkm,
la.total_area_sq_mi,
rg.region,
rg.income_group,
((forest_area_sqkm/(total_area_sq_mi*2.59))*100) AS forest_area_percent
FROM forest_area fa
JOIN land_area la
ON fa.country_code=la.country_code
AND fa.year=la.year
JOIN regions rg
ON rg.country_code=la.country_code );
```

GLOBAL SITUATION

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

```
WITH T1 AS
(SELECT fa.country_code,
fa.country_name,
fa.year,
fa.forest_area_sqkm
FROM forest_area fa
WHERE year=1990 )
SELECT T1.year,
CAST(SUM(forest_area_sqkm) AS DECIMAL(18,
2)) AS total_forest_area
FROM T1
GROUP BY 1;
```

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

```
WITH T1 AS
(SELECT fa.country_code,
fa.country_name,
fa.year,
fa.forest_area_sqkm
FROM forest_area fa
WHERE year=2016)
SELECT T1.year,
CAST(SUM(forest_area_sqkm) AS DECIMAL(18,
2)) AS total_forest_area
FROM T1
GROUP BY 1;
```

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

```
WITH T1 AS
(SELECT CAST(SUM(fa.forest_area_sqkm) AS DECIMAL(18,
2)) AS total_1990 FROM
(SELECT country_code,
country_name,
year,
forest_area_sqkm
FROM forest_area
WHERE year=1990 ) AS fa ), T2 AS
(SELECT CAST(SUM(fa.forest_area_sqkm) AS DECIMAL(18,
2)) AS total_2016 FROM
(SELECT country_code,
country_name,
year,
forest_area_sqkm
FROM forest_area
WHERE year=2016 ) AS fa )
SELECT (T1.total_1990-T2.total_2016) AS difference,
CAST(((T1.total_1990-T2.total_2016)/T1.total_1990)*100 AS DECIMAL(18,
2)) AS percentage
FROM T1, T2;
```

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

```
WITH T1 AS
(SELECT CAST(SUM(fa.forest_area_sqkm) AS DECIMAL(18,
2)) AS total_1990 FROM
(SELECT country_code,
country_name,
year,
forest_area_sqkm
```

```
FROM forest_area
WHERE year=1990 ) AS fa ), T2 AS
(SELECT CAST(SUM(fa.forest_area_sqkm) AS DECIMAL(18,
2)) AS total_2016 FROM
(SELECT country_code,
country_name,
year,
forest_area_sqkm
FROM forest_area
WHERE year=2016 ) AS fa )
SELECT (T1.total_1990-T2.total_2016) AS difference,
CAST(((T1.total_1990-T2.total_2016)/T1.total_1990)*100 AS DECIMAL(18,
2)) AS percentage
FROM T1, T2;
```

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 la.country_code,
la.country_name,
la.year,
la.total_area_sqKM from
(SELECT *,
CAST((total_area_sq_mi*2.59) AS DECIMAL(18,
2)) AS total_area_sqKM
FROM land_area
WHERE year=2016 ) la
WHERE la.total_area_sqKM <= 2191038.09
ORDER BY la.total_area_sqKM DESC LIMIT 1;
```

REGIONAL OUTLOOK

Create a table that shows the Regions and their percent forest area (sum of forest area divided by sum of land area) in 1990 and 2016. (Note that 1 sq mi = 2.59 sq km).

```
WITH T2 AS
(SELECT *,
((T1.total_forest_area/T1.total_land_area)*100) AS forest_area_percent
FROM
(SELECT year,
region,
SUM(forest_area_sqkm) AS total_forest_area,
SUM(total_area_sq_mi*2.59) AS total_land_area
FROM forestation
WHERE year=1990
GROUP BY 1,2 ) T1 ), T3 AS
(SELECT year,
SUM(T2.total_forest_area) AS global_forest_area,
SUM(T2.total_land_area) AS global_land_area
FROM T2
GROUP BY 1 )
SELECT T3.year,
CAST(T3.global_forest_area AS DECIMAL(18,
2)),
CAST(T3.global_land_area AS DECIMAL(18,
2)),
CAST((T3.global_forest_area/T3.global_land_area)*100 AS DECIMAL(18,
2)) AS global_forest_percent
FROM T3;
```

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?

```
WITH T2 AS
(SELECT *,
CAST(((T1.total_forest_area/T1.total_land_area)*100) AS DECIMAL(18,
2)) AS forest_area_percent
FROM
(SELECT year,
region,
SUM(forest_area_sqkm) AS total_forest_area,
SUM(total_area_sq_mi*2.59) AS total_land_area
FROM forestation
WHERE year=2016
GROUP BY 1,2 ) T1 )
SELECT year,
region,
```

```
CAST(total_forest_area AS DECIMAL(18,
2)),
CAST(total_land_area AS DECIMAL(18,
2)),
forest_area_percent
FROM T2
ORDER BY 5 DESC;
```

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?

```
WITH T2 AS
(SELECT *,
CAST(((T1.total_forest_area/T1.total_land_area)*100) AS DECIMAL(18,
2)) AS forest_area_percent
FROM
(SELECT year,
region,
SUM(forest_area_sqkm) AS total_forest_area,
SUM(total_area_sq_mi*2.59) AS total_land_area
FROM forestation
WHERE year=1990
GROUP BY 1,2 ) T1 )
SELECT year,
region,
CAST(total_forest_area AS DECIMAL(18,
2)),
CAST(total_land_area AS DECIMAL(18,
2)),
forest_area_percent
FROM T2
ORDER BY 5 DESC;
```

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

```
WITH T2 AS
(SELECT *,
CAST(((T1.total_forest_area/T1.total_land_area)*100) AS DECIMAL(18,
2)) AS forest_area_percent
FROM
(SELECT year,
region,
SUM(forest_area_sqkm) AS total_forest_area,
SUM(total_area_sq_mi*2.59) AS total_land_area
FROM forestation
```

```
WHERE year=1990
GROUP BY 1,2 ) T1 ), T3 AS
(SELECT *,
CAST(((T1.total_forest_area/T1.total_land_area)*100) AS DECIMAL(18,
2)) AS forest_area_percent
FROM
(SELECT year,
region,
SUM(forest_area_sqkm) AS total_forest_area,
SUM(total_area_sq_mi*2.59) AS total_land_area
FROM forestation
WHERE year=2016
GROUP BY 1,2 ) T1 )
SELECT T3.year,
T3.region,
CAST(T3.total_forest_area AS DECIMAL(18,
2)),
CAST(T3.total_land_area AS DECIMAL(18,
2)),
T3.forest_area_percent
FROM T2
JOIN T3
ON T2.region = T3.region
WHERE T3.forest_area_percent < T2.forest_area_percent
ORDER BY 5 DESC;
```

COUNTRY-LEVEL DETAIL

Which country saw the largest amount increase in forest area from 1990 to 2016?

```
WITH T1 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=2016
AND forest_area_sqkm is NOT null), T2 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=1990
AND forest_area_sqkm is NOT null), T3 AS
(SELECT T1.country_code,
T1.country_name,
T1.year,
(T1.forest_area_sqkm-T2.forest_area_sqkm) AS increased_amount
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code,
T3.country_name,
CAST(T3.increased_amount AS DECIMAL(18,2))
FROM T3
ORDER BY T3.increased_amount DESC;
```

What was the change in sq km?

```
WITH T1 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=2016
AND forest_area_sqkm is NOT null), T2 AS
(SELECT country_code,
country_name,
year,
```

```
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=1990
AND forest_area_sqkm is NOT null), T3 AS
(SELECT T1.country_code,
T1.country_name,
T1.year,
(T1.forest_area_sqkm-T2.forest_area_sqkm) AS increased_amount
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code,
T3.country_name,
CAST(T3.increased_amount AS DECIMAL(18,2))
FROM T3
ORDER BY T3.increased_amount DESC;
```

Which country saw the 2nd largest increase over this time period?

```
WITH T1 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=2016
AND forest_area_sqkm is NOT null), T2 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=1990
AND forest_area_sqkm is NOT null), T3 AS
(SELECT T1.country_code,
T1.country_name,
T1.year,
(T1.forest_area_sqkm-T2.forest_area_sqkm) AS increased_amount
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code,
T3.country_name,
```

```
CAST(T3.increased_amount AS DECIMAL(18,2))
FROM T3
ORDER BY T3.increased_amount DESC;
```

What was the change in sq km?

```
WITH T1 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=2016
AND forest_area_sqkm is NOT null), T2 AS
(SELECT country_code,
country_name,
year,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=1990
AND forest_area_sqkm is NOT null), T3 AS
(SELECT T1.country_code,
T1.country_name,
T1.year,
(T1.forest_area_sqkm-T2.forest_area_sqkm) AS increased_amount
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code,
T3.country_name,
CAST(T3.increased_amount AS DECIMAL(18,2))
FROM T3
ORDER BY T3.increased_amount DESC;
```

Which country saw the largest percent increase in forest area from 1990 to 2016?

```
WITH T1 AS (
SELECT country_code
,country_name
,year
,forest_area_sqkm
,(total_area_sq_mi*2.59) AS total_area_sqkm
,forest_area_percent
FROM forestation
WHERE year=2016
```

```
AND forest_area_percent is NOT null), T2 AS (
SELECT country_code
,country_name
,year
,forest_area_sqkm
,(total_area_sq_mi*2.59) AS total_area_sqkm
,forest_area_percent
FROM forestation
WHERE year=1990
AND forest_area_percent is NOT null), T3 AS (
SELECT T1.country_code
,T1.country_name
,T1.year
,T2.forest_area_sqkm AS forest_area_1990
,T2.total_area_sqkm AS total_area_sqkm_1990
,T1.forest_area_sqkm AS forest_area_2016
,T1.total_area_sqkm AS total_area_sqkm_2016
,(T1.forest_area_percent-T2.forest_area_percent) AS increased_percent
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code
,T3.country_name
,T3.forest_area_1990
,T3.total_area_sqkm_1990
,T3.forest_area_2016
,T3.total_area_sqkm_2016
,CAST(T3.increased_percent AS DECIMAL(18,2))
FROM T3
ORDER BY T3.increased_percent DESC;
```

What was the percent change to 2 decimal places?

```
WITH T1 AS (
SELECT country_code
,country_name
,year
,forest_area_sqkm
,(total_area_sq_mi*2.59) AS total_area_sqkm
,forest_area_percent
FROM forestation
WHERE year=2016
AND forest_area_percent is NOT null), T2 AS (
SELECT country_code
,country_name
,year
```

```
,forest_area_sqkm
,(total_area_sq_mi*2.59) AS total_area_sqkm
,forest_area_percent
FROM forestation
WHERE year=1990
AND forest_area_percent is NOT null), T3 AS (
SELECT T1.country_code
,T1.country_name
,T1.year
,T2.forest_area_sqkm AS forest_area_1990
,T2.total_area_sqkm AS total_area_sqkm_1990
,T1.forest_area_sqkm AS forest_area_2016
,T1.total_area_sqkm AS total_area_sqkm_2016
,(T1.forest_area_percent-T2.forest_area_percent) AS increased_percent
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code
,T3.country_name
,T3.forest_area_1990
,T3.total_area_sqkm_1990
,T3.forest_area_2016
,T3.total_area_sqkm_2016
,CAST(T3.increased_percent AS DECIMAL(18,2))
FROM T3
ORDER BY T3.increased_percent DESC;
```

Which 5 countries saw the largest amount decrease in forest area from 1990 to 2016? What was the percent change to 2 decimal places?

```
WITH T1 AS
(SELECT country_code,
country_name,
year,
region,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=2016
AND forest_area_sqkm is NOT null), T2 AS
(SELECT country_code,
country_name,
year,
region,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
```

```
FROM forestation
WHERE year=1990
AND forest_area_sqkm is NOT null), T3 AS
(SELECT T1.country_code,
T1.country_name,
T1.year,
T2.region,
(T1.forest_area_sqkm-T2.forest_area_sqkm) AS decreased_amount
FROM T1
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code,
T3.country_name,
T3.region,
CAST(T3.decreased_amount AS DECIMAL(18,
2))
FROM T3
ORDER BY T3.decreased_amount ASC;
```

What was the difference in forest area?

```
WITH T1 AS
(SELECT country_code,
country_name,
year,
region,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=2016
AND forest_area_sqkm is NOT null), T2 AS
(SELECT country_code,
country_name,
year,
region,
forest_area_sqkm,
(total_area_sq_mi*2.59) AS total_area_sqkm
FROM forestation
WHERE year=1990
AND forest_area_sqkm is NOT null), T3 AS
(SELECT T1.country_code,
T1.country_name,
T1.year,
T2.region,
(T1.forest_area_sqkm-T2.forest_area_sqkm) AS decreased_amount
FROM T1
```

```
JOIN T2
ON T1.country_code = T2.country_code)
SELECT T3.country_code,
T3.country_name,
T3.region,
CAST(T3.decreased_amount AS DECIMAL(18,
2))
FROM T3
ORDER BY T3.decreased_amount ASC;
```

If countries were grouped by percent forestation in quartiles, which group had the most countries in it in 2016?
List all of the countries that were in the 4th quartile (percent forest > 75%) in 2016.

```
SELECT quartiles.percentile AS percentile
,COUNT(quartiles.percentile) AS number_of_cuntries
FROM
(
SELECT country_code
,country_name
,year
,region
,forest_area_sqkm
,(total_area_sq_mi*2.59) AS total_area_sqkm
,forest_area_percent
,NTILE(4) OVER(PARTITION BY year ORDER BY forest_area_percent) AS percentile
FROM forestation
WHERE year = 2016
AND forest_area_percent is not null
) AS quartiles
GROUP BY percentile;
```

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

```
SELECT country_code
,country_name
,year
,region
,forest_area_sqkm
,(total_area_sq_mi*2.59) AS total_area_sqkm
,forest_area_percent
,NTILE(4) OVER(PARTITION BY year ORDER BY forest_area_percent) AS percentile
FROM forestation
WHERE year = 2016
AND forest_area_percent is not null
ORDER BY forest_area_percent DESC
LIMIT 3;
```