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 km2_ in 1990. As of 2016, the most recent year for which data was available, that number had fallen to _ 39958245.9 km2_, a loss of _ 1324449 km2_, or **3,208%.**

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 **1279999,98 km2**)

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
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
World	32.42	31.38

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 527229,062 km2 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 km2 much lower than the figure for China

United States and China 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	282193.9844
Myanmar	East Asia & Pacific	107234.0039
Nigeria	Sub-Saharan Africa	106506.001
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	-61.8
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 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
0-25%	85
25-50%	72
50-75%	38
75-100%	9

The largest number of countries in 2016 were found in the 1(0-25%) 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
American Samoa	East Asia & Pacific	87.50009
Gabon	Sub-Saharan Africa	90.03764
Guyana	Latin America & Caribbean	83.90145
Lao PDR	East Asia & Pacific	82.10823
Micronesia, Fed. Sts.	East Asia & Pacific	91.85724
Palau	East Asia & Pacific	87.60681
Seychelles	Sub-Saharan Africa	88.41114
Solomon Islands	East Asia & Pacific	77.86352
Suriname	Latin America & Caribbean	98.25769

4. RECOMMENDATIONS

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

- *What have you learned from the World Bank data?*

  According to World Bank data, the area as well as the rate in Latin America & the Caribbean and Sub-Saharan Africa is decreasing sharply, especially countries in Sub-Saharan Africa such as Togo,... with a decrease of up to 75%. By 2016, only a few countries had forest area >75% and were concentrated in East Asia & Pacific.

- *Which countries should we focus on over others?*
  From Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016: we can see that these countries have a very large decrease of more than 75%. We need to focus on these countries first, even the whole Sub-Saharan Africa region. Some countries with particularly large reductions that need to be stopped are Brazil, Indonesia .... we need to promote to stop deforestation in these countries

5. APPENDIX: SQL Queries Used

5.1. VIEW

Create a View called “forestation” by joining all three tables - forest_area, land_area, and regions in the workspace.

```
create view forestation as
select fa.country_code,
       fa.country_name,
       fa.year,
       fa.forest_area_sqkm,
       la.total_area_sq_mi * 2.59                                  as total_area_sqkm,
       (fa.forest_area_sqkm / (la.total_area_sq_mi * 2.59)) * 100 as forest_percent,
       r.region,
       r.income_group
from forest_area as fa
         join land_area as la on la.country_code = fa.country_code and la.year = fa.year
         join regions as r on fa.country_code = r.country_code
order by country_code;
```

5.2. Global Situation

a. What was the total forest area (in sq km) of the world in 1990? Please keep in mind that you can use the country record denoted as “World" in the region table.

```
select forest_area_sqkm as total_forest_area
from forestation
where year = 1990 and country_name = 'World';
```

b. What was the total forest area (in sq km) of the world in 2016? Please keep in mind that you can use the country record in the table is denoted as “World.”

```
select forest_area_sqkm as total_forest_area
from forestation
where year = 2016 and country_name = 'World';
```

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

```
select cur.forest_area_sqkm - pre.forest_area_sqkm as dif_area
from forest_area as cur
         join forest_area as pre
              on (
                  cur.year = '2016'
                      and pre.year = '1990'
                      and cur.country_name = 'World'
                      and pre.country_name = 'World'
                  );
```

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

```
select ((pre.forest_area_sqkm - cur.forest_area_sqkm) / pre.forest_area_sqkm)
         * 100 as dif_percent
from forest_area as cur
```

```
        join forest_area as pre
             on (
                 cur.year = '2016'
                     and pre.year = '1990'
                     and cur.country_name = 'World'
                     and pre.country_name = 'World'
                 );
```

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,
       total_area_sqkm,
       ABS((total_area_sqkm)
        - (select pre.forest_area_sqkm - cur.forest_area_sqkm as dif_area
                                  from forest_area as cur
                                           join forest_area as pre
                                           on (
                                               cur.year = '2016'
                                               and pre.year = '1990'
                                               and cur.country_name = 'World'
                                               and pre.country_name = 'World'
                                               ))) as dif
from forestation
where year = '2016'
order by dif limit 1
```

5.3. Regional Outlook

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

```
create view region_forest as
select region.*, (region.total_forest / region.total_area) * 100 as percent_forest
from (select region, year, sum (forest_area_sqkm) as total_forest, sum
(total_area_sqkm) as total_area
      from forestation
      group by region, year
      having (year = 2016 or year = 1990)) as region
order by region, year
```

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 round(cast(percent_forest as numeric),2) as percent_forest_world
from region_forest where year = 2016 and region = 'World';
```

```
select region,
       round(cast(total_forest as numeric), 2)          as total_area,
       round(cast(percent_forest as numeric), 2)        as percent_forest
from region_forest
where year = 2016
  and round(cast (percent_forest as numeric), 2)
    = (select max (round(cast (percent_forest as numeric), 2)) as max_percent
```

```
    from region_forest
    where year = 2016)
```

```
select region,
       round(cast(total_forest as numeric), 2)          as total_area,
       round(cast(percent_forest as numeric), 2)        as percent_forest
from region_forest
where year = 2016
  and round(cast (percent_forest as numeric), 2)
    = (select min (round(cast (percent_forest as numeric), 2)) as max_percent
    from region_forest
    where year = 2016)
```

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 round(cast(percent_forest as numeric),2) as percent_forest_world
from region_forest where year = 1990 and region = 'World';
```

```
select region,
       round(cast(total_forest as numeric), 2)          as total_area,
       round(cast(percent_forest as numeric), 2)        as percent_forest
from region_forest
where year = 1990
  and round(cast (percent_forest as numeric), 2)
    = (select max (round(cast (percent_forest as numeric), 2)) as max_percent
    from region_forest
    where year = 1990)
```

```
select region,
       round(cast(total_forest as numeric), 2)          as total_area,
       round(cast(percent_forest as numeric), 2)        as percent_forest
from region_forest
where year = 1990
  and round(cast (percent_forest as numeric), 2)
    = (select min (round(cast (percent_forest as numeric), 2)) as max_percent
    from region_forest
    where year = 1990)
```

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

```
select a.region,
       round(cast(a.percent_forest as numeric), 2) as percent_forest_1990,
       round(cast(b.percent_forest as numeric), 2) as percent_forest_2016
from (select * from region_forest where year = 1990) as a
     join (select * from region_forest where year = 2016) b on a.region = b.region
where a.percent_forest > b.percent_forest
```

5.4. Country-Level Detail

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?

```
select _1990.country_code,
       _1990.country_name,
       r.region,
       _1990.forest_area_sqkm                          as forest_1990,
       _2016.forest_area_sqkm                          as forest_2016,
       _1990.forest_area_sqkm - _2016.forest_area_sqkm as change_forest
from (select * from forest_area where year = 1990) as _1990
         join (select * from forest_area where year = 2016) as _2016
              on _1990.country_code = _2016.country_code
         join regions as r on _2016.country_code = r.country_code
where _1990.forest_area_sqkm is not null
  and _2016.forest_area_sqkm is not null
  and r.country_name != 'World'
order by change_forest desc limit 5
```

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?

```
select _1990.country_code,
       _1990.country_name,
       r.region,
       _1990.forest_area_sqkm                                    as forest_1990,
       _2016.forest_area_sqkm                                    as forest_2016,
       _1990.forest_area_sqkm - _2016.forest_area_sqkm           as change_forest,
       round(
               cast(
                       (
                           (_2016.forest_area_sqkm - _1990.forest_area_sqkm)
                               / _1990.forest_area_sqkm * 100) as numeric), 2)
                                                                 as change_percent
from (select * from forest_area where year = 1990) as _1990
         join (select * from forest_area where year = 2016) as _2016
              on _1990.country_code = _2016.country_code
         join regions as r on _2016.country_code = r.country_code
where _1990.forest_area_sqkm is not null
  and _2016.forest_area_sqkm is not null
  and r.country_name != 'World'
order by change_percent limit 5
```

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

```
with temp as (
    select country_name,
        case
            when forest_percent < 25 then 'Q1'
            when forest_percent >= 25 and forest_percent < 50 then 'Q2'
            when forest_percent >= 50 and forest_percent < 75 then 'Q3'
            else 'Q4' end as quartiles
    from forestation
    where year = 2016 and forest_percent is not null
    )
select distinct
      quartiles,
```

```
      (count(country_name) over (partition by quartiles)) as countries
from temp
order by quartiles
```

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

```
select distinct country_name, region, forest_percent
from forestation
where forest_percent > 75 and year = 2016
```

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_percent > (
                            select forest_percent
                            from forestation
                            where country_name = 'United States' and year =2016
                        )
```