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 3.2%.

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 1279999.99sqkm).

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

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 (dropped from 30.67% to 28.79%) and Latin America & Caribbean (51.03% to 46.16%). 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 527229.06sqkm. 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 79200sqkm, 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 sqkm
Indonesia	East Asia & Pacific	282194 sqkm
Myanmar	East Asia & Pacific	107234 sqkm
Nigeria	Sub-Saharan Africa	106506 sqkm
Tanzania	Sub-Saharan Africa	102320 sqkm

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 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
Solomon Islands	East Asia & Pacific	77.86%
Lao PDR	East Asia & Pacific	82.11%
Guyana	Latin America & Caribbean	83.90%
American Samoa	East Asia & Pacific	87.50%
Palau	East Asia & Pacific	87.61%
Seychelles	Sub-Saharan Africa	88.41%
Gabon	Sub-Saharan Africa	90.04%
Micronesia, Fed. Sts.	East Asia & Pacific	91.86%
Suriname	Latin America & Caribbean	98.26%

5. 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?*

According to World Bank data from 1990 to 2016, our world forest area is shrinking due to forest area loss of two regions Sub-Saharan Africa and Latin America & Caribbean. All other regions increased in forest area over this time period.

The data suggest that, we should focus on the countries facing major decrement in forest area. Those countries are Brazil, Indonesia, Myanmar, Nigeria, and Tanzania (Table 3.1). Countries like Togo, Nigeria, Uganda, Mauritania, Honduras also at risk for loosing high percentage of forest (Table 3.2) which may impact them as individual. Nigeria is the most concerned country to be focus on and needs initiative as quickly as possible in order to sustain. We can start campaign to understand the exact situation over here.

As a success China has shown remarkable increase in its forest land. Hence, we should acquire some best practices from them to implement. As a whole world initiative, we should enforce some rules for all countries to protect their forest.

APPENDIX: SQL queries used

```
----------------------------------------------------------------------
--Deforestation Exploration
----------------------------------------------------------------------

--Prechecks :
--No duplicates for country and years present.


--Drop forestation view if existing before creation.

DROP VIEW forestation;

--Create/Replace forestation view.
--Conversion applied as 1 sq mi = 2.59 sq km
```

```sql
CREATE VIEW forestation AS
SELECT r.country_code AS country_code,
  r.country_name AS country_name,
  f.year AS in_year,
  f.forest_area_sqkm AS forest_area_sqkm,
  l.total_area_sq_mi AS total_area_sq_mi,
  r.region AS region,
  r.income_group reg_income_group,
  (forest_area_sqkm/(total_area_sq_mi*2.59))*100 AS percent_of_l_as_f
FROM forest_area f
JOIN land_area l
ON f.country_code = l.country_code AND f.year = l.year
FULL JOIN regions r
ON r.country_code = f.country_code
ORDER BY r.country_code;

--view data for forestation
select * from forestation;



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--1. GLOBAL SITUATION
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--(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
FROM forestation f
WHERE in_year = 1990 AND country_name = 'World';

--Result: 41282694.9 sqkm


--(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
FROM forestation f
WHERE in_year = 2016 AND country_name = 'World';

--Result : 39958245.9 sqkm
```

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

SELECT forest_area_sqkm -
  (SELECT forest_area_sqkm
    FROM forestation f
    WHERE in_year = 2016 AND country_name = 'World') f_area_diff
FROM forestation f
WHERE in_year = 1990 AND country_name = 'World';

--Result: 1324449 sqkm




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

WITH t1 AS
  (SELECT country_name, forest_area_sqkm AS f_area16_sqkm
  FROM forestation f
  WHERE in_year = 2016 AND country_name = 'World'
  ),
t2 AS (
  SELECT country_name, forest_area_sqkm AS f_area90_sqkm
  FROM forestation f
  WHERE in_year = 1990 AND country_name = 'World'
)
SELECT ((t2.f_area90_sqkm - t1.f_area16_sqkm)/t2.f_area90_sqkm)*100 AS pecent_change
FROM t1
JOIN t2
ON t1.country_name = t2.country_name

--result: 3.2 %



--- (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?



WITH t1 AS(
  SELECT country_name, forest_area_sqkm
  FROM forestation
  WHERE in_year = 2016 AND country_name = 'World'
  ),
t2 AS (
  SELECT country_name, forest_area_sqkm
```

```
  FROM forestation
  WHERE in_year = 1990 AND country_name = 'World'
),
t3 AS (
  SELECT t1.country_name, t2.forest_area_sqkm - t1.forest_area_sqkm as loss_90_16
  FROM t1
  JOIN t2
  ON t1.country_name = t2.country_name
)
/*Calculate the lowest difference between forest area lost and total area of each
country as listed in 2016.*/
SELECT country_name, (total_area_sq_mi*2.59) AS total_area_in_sqkm,
  ABS((total_area_sq_mi * 2.59) - (SELECT loss_90_16 FROM t3)) AS diff
FROM forestation
WHERE in_year = 2016
ORDER BY diff ASC
LIMIT 1

/*
Result :  Peru  1279999.99sqkm
*/

--------------------
--2. REGIONAL OUTLOOK
--------------------

--- (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?

WITH t_data16 AS (
  SELECT region,
 (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 as prcnt_forest_16
  FROM forestation
  WHERE in_year = 2016
  GROUP BY region
 )
SELECT region, ROUND(CAST(prcnt_forest_16 AS numeric),2) as r_prcnt_forest_16
FROM t_data16
ORDER BY r_prcnt_forest_16

/* Result:
region                              r_prcnt_forest_16
Middle East & North Africa          2.07
South Asia                              17.51
East Asia & Pacific                 26.36
Sub-Saharan Africa                  28.79
World                   31.38
North America                       36.04
```

```
Europe & Central Asia       38.04
Latin America & Caribbean           46.16
*/

--- (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?


WITH t_data90 AS (
  SELECT region,
    (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 as prcnt_forest_90
  FROM forestation
  WHERE in_year = 1990
  GROUP BY region
 )
SELECT region, ROUND(CAST(prcnt_forest_90 AS numeric),2) as r_prcnt_forest_90
FROM t_data90
ORDER BY r_prcnt_forest_90


/*
region                              r_prcnt_forest_90
Middle East & North Africa      1.78
South Asia              16.51
East Asia & Pacific         25.78
Sub-Saharan Africa          30.67
World                   32.42
North America           35.65
Europe & Central Asia       37.28
Latin America & Caribbean       51.03
*/

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

WITH t_data16 AS (
  SELECT region,
 (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 as prcnt_forest_16
  FROM forestation
  WHERE in_year = 2016
  GROUP BY region
),
t_data90 AS (
  SELECT region,
    (SUM(forest_area_sqkm) / SUM(total_area_sq_mi*2.59))*100 as prcnt_forest_90
  FROM forestation
  WHERE in_year = 1990
  GROUP BY region
```

```
 )

SELECT t_data90.region, ROUND(CAST(prcnt_forest_90 AS numeric),2) as
r_prcnt_forest_90,
  ROUND(CAST(prcnt_forest_16 AS numeric),2) as r_prcnt_forest_16
FROM t_data16
JOIN t_data90
ON t_data90.region = t_data16.region
WHERE ROUND(CAST(prcnt_forest_90 AS numeric),2) > ROUND(CAST(prcnt_forest_16 AS
numeric),2)
AND t_data90.region != 'World'
ORDER BY r_prcnt_forest_90;

/* Result:
region                      r_prcnt_forest_90      r_prcnt_forest_16
Sub-Saharan Africa          30.67                  28.79
Latin America & Caribbean   51.03                  46.16
*/




-----------------------------------------
--3. 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?


WITH t1990 AS (
  SELECT country_code,
    country_name,
    region,
    forest_area_sqkm
  FROM forestation fa
  WHERE in_year = 1990 AND forest_area_sqkm IS NOT NULL AND country_name != 'World'
),
t2016 AS (
  SELECT country_code,
    country_name,
    region,
    forest_area_sqkm
  FROM forestation fa
  WHERE in_year = 2016 AND forest_area_sqkm IS NOT NULL AND country_name != 'World'
)
SELECT t2016.country_code,
  t2016.country_name,
```

```
  t2016.region,
  t1990.forest_area_sqkm - t2016.forest_area_sqkm AS change_sqkm
FROM t1990
JOIN t2016
ON t1990.country_code = t2016.country_code
AND (t1990.forest_area_sqkm IS NOT NULL AND t2016.forest_area_sqkm IS NOT NULL)
ORDER BY 4 DESC
LIMIT 5;

/*
Result:
country_code    country_name        region                          change_sqkm
BRA           Brazil                Latin America & Caribbean       541510
IDN           Indonesia     East Asia & Pacific                 282193.9844
MMR           Myanmar           East Asia & Pacific                 107234.0039
NGA           Nigeria               Sub-Saharan Africa                  106506.001
TZA           Tanzania          Sub-Saharan Africa                  102320
*/


-- calculating countries saw the largest increase in forest area.
/*
country_code    country_name            region                  change_sqkm
CHN           China         East Asia & Pacific 527229.062
USA           United States         North America   79200
*/

-- 2 largest countries in total land area (Extra query)
SELECT country_name,
  MAX(total_area_sq_mi) as tol_l_area
FROM forestation f
WHERE country_name != 'World'
AND total_area_sq_mi IS NOT NULL
GROUP BY country_name
ORDER BY 2 DESC
LIMIT 2;

/*
Russian Federation  6328166.02
China                   3624806.95
*/

--- (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 t1990 AS (
  SELECT country_code,
```

```
    country_name,
    region,
    forest_area_sqkm
  FROM forestation
  WHERE in_year = 1990 AND forest_area_sqkm IS NOT NULL AND country_name != 'World'
),
t2016 AS (
  SELECT country_code,
    country_name,
    region,
    forest_area_sqkm
  FROM forestation
  WHERE in_year = 2016 AND forest_area_sqkm IS NOT NULL AND country_name != 'World'
)
SELECT t2016.country_code,
  t2016.country_name,
  t2016.region,
  ROUND(CAST((((t1990.forest_area_sqkm -
t2016.forest_area_sqkm)/t1990.forest_area_sqkm)*100) AS numeric),2) AS percnt_change
FROM t1990
JOIN t2016
ON t1990.country_code = t2016.country_code
AND (t1990.forest_area_sqkm IS NOT NULL AND t2016.forest_area_sqkm IS NOT NULL)
ORDER BY 4 DESC
LIMIT 5;

/*
Result :
country_code    country_name    region                              percnt_change
TGO           Togo                Sub-Saharan Africa      75.45
NGA           Nigeria             Sub-Saharan Africa      61.80
UGA           Uganda              Sub-Saharan Africa      59.13
MRT           Mauritania        Sub-Saharan Africa            46.75
HND           Honduras          Latin America & Caribbean   45.03
*/



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


WITH tbl_2016 AS (
  SELECT
    country_code,
    country_name,forest_area_sqkm, total_area_sq_mi, percent_of_l_as_f, in_year
  FROM forestation
```

```sql
  WHERE country_name != 'World' AND percent_of_l_as_f IS NOT NULL AND total_area_sq_mi
IS NOT NULL
  AND in_year = 2016
  ORDER BY percent_of_l_as_f DESC
),
tbl_quartile AS (
  SELECT country_code,
        country_name,
        forest_area_sqkm,
        total_area_sq_mi,
        percent_of_l_as_f,
        in_year,
        CASE WHEN percent_of_l_as_f > 0 AND percent_of_l_as_f <= 25 THEN 1
        WHEN percent_of_l_as_f > 25 AND percent_of_l_as_f <= 50 THEN 2
        WHEN percent_of_l_as_f > 50 AND percent_of_l_as_f <= 75 THEN 3
        WHEN percent_of_l_as_f > 75 AND percent_of_l_as_f <= 100 THEN 4
        END AS quartile_num
  FROM tbl_2016
)
SELECT quartile_num, count(*) as tol_num_of_country
FROM tbl_quartile
GROUP BY quartile_num
ORDER BY 2 DESC;



/*Result:
quartile_num    tol_num_of_country
1               85
2               72
3               38
4               9
*/


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

WITH tbl_2016 AS (
  SELECT
    country_code,
    country_name,
    region,
    forest_area_sqkm,
    total_area_sq_mi,
    percent_of_l_as_f,
    in_year
```

```
  FROM forestation
  WHERE country_name != 'World' AND forest_area_sqkm IS NOT NULL AND total_area_sq_mi
IS NOT NULL
  AND in_year = 2016
  ORDER BY percent_of_l_as_f DESC
),
tbl_quartile AS (
  SELECT
        country_code,
        country_name,
        region,
        forest_area_sqkm,
        total_area_sq_mi,
        percent_of_l_as_f,
        in_year,
        CASE WHEN percent_of_l_as_f > 0 AND percent_of_l_as_f <= 25 THEN 1
        WHEN percent_of_l_as_f > 25 AND percent_of_l_as_f <= 50 THEN 2
        WHEN percent_of_l_as_f > 50 AND percent_of_l_as_f <= 75 THEN 3
        WHEN percent_of_l_as_f > 75 AND percent_of_l_as_f <= 100 THEN 4
        END AS quartile_num
  FROM tbl_2016
)
SELECT
  country_name,
  region,
  ROUND(CAST(percent_of_l_as_f AS numeric),2) AS pct_of_l_as_f
FROM tbl_quartile
WHERE quartile_num = 4
ORDER BY 3;


/*Result:
country_name                    region                              pct_of_l_as_f
Solomon Islands             East Asia & Pacific         77.86
Lao PDR         East Asia & Pacific         82.11
Guyana                  Latin America & Caribbean   83.90
American Samoa      East Asia & Pacific         87.50
Palau                           East Asia & Pacific         87.61
Seychelles                  Sub-Saharan Africa              88.41
Gabon                           Sub-Saharan Africa              90.04
Micronesia, Fed. Sts.       East Asia & Pacific         91.86
Suriname                    Latin America & Caribbean   98.26
*/


--- (e) How many countries had a percent forestation higher than the United States in
2016?
```

```sql
WITH tbl_2016 AS (
  SELECT
    country_code,
    country_name,
    region,
    forest_area_sqkm,
    total_area_sq_mi,
    percent_of_l_as_f,
    in_year
  FROM forestation
  WHERE country_name != 'World' AND forest_area_sqkm IS NOT NULL AND total_area_sq_mi
IS NOT NULL
  AND in_year = 2016
  ORDER BY percent_of_l_as_f DESC
)
SELECT
  count(country_name)
FROM tbl_2016
WHERE percent_of_l_as_f > (SELECT percent_of_l_as_f FROM tbl_2016
WHERE country_code = 'USA')

/*Result:
count
94
*/

/*END of Queries*/
```