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 km²** in 1990. As of 2016, the most recent year for which data was available, that number had fallen to **39958245 km²**, a loss of **1324449 km²** or **3.20**%.

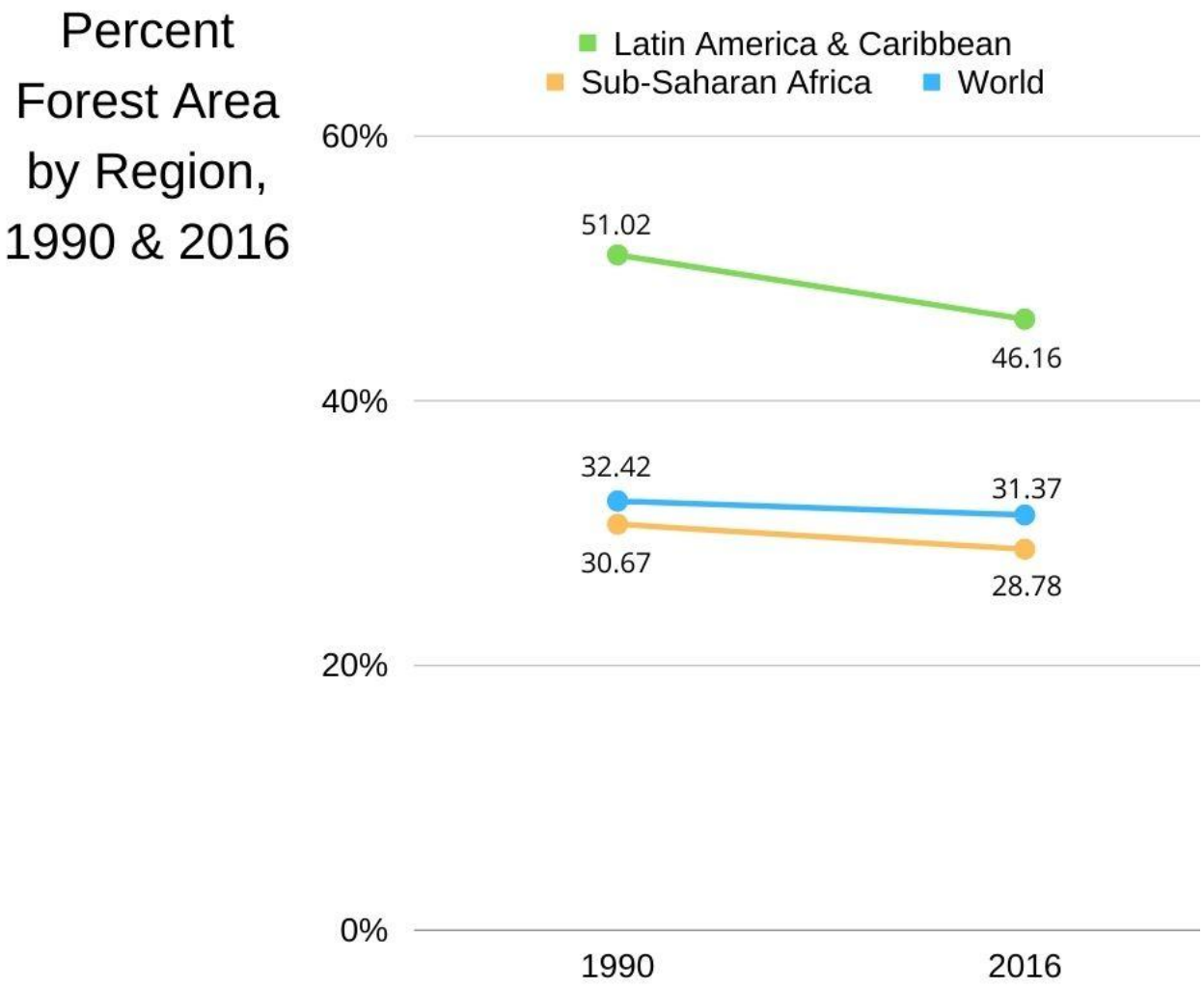
The forest area lost over this time period is slightly more than the entire land area of **Peru** listed for the year 2016 (which is **1,279,999.98 km²**).

2. REGIONAL OUTLOOK

In 2016, the percentage of the total land area of the world designated as forest was **31.37**%. 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 **2.06**% forestation.

In 1990, the percentage 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 **51.02**%, and the region with the lowest relative forestation was **Middle East & North Africa**, with **1.77**% forestation.

Table 2.1:



The only regions of the world that decreased in percent forest area from 1990 to 2016 were **Latin America & Caribbean** (dropped from **51.02**% to **46.16** %) and **Sub-Saharan Africa** (**30.67**% to **28.78**%). 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 **31.37**%.

3. COUNTRY-LEVEL DETAIL

SUCCESS STORIES

There is one particularly bright spot in the data at the country level, **China**. This country actually increased its forest area from 1990 to 2016 by **527,229.06 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 **79,200 km²**, much lower than the figure for **China**.

China and the **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's** 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 5 countries had the largest decrease in forest area over the time period under consideration:

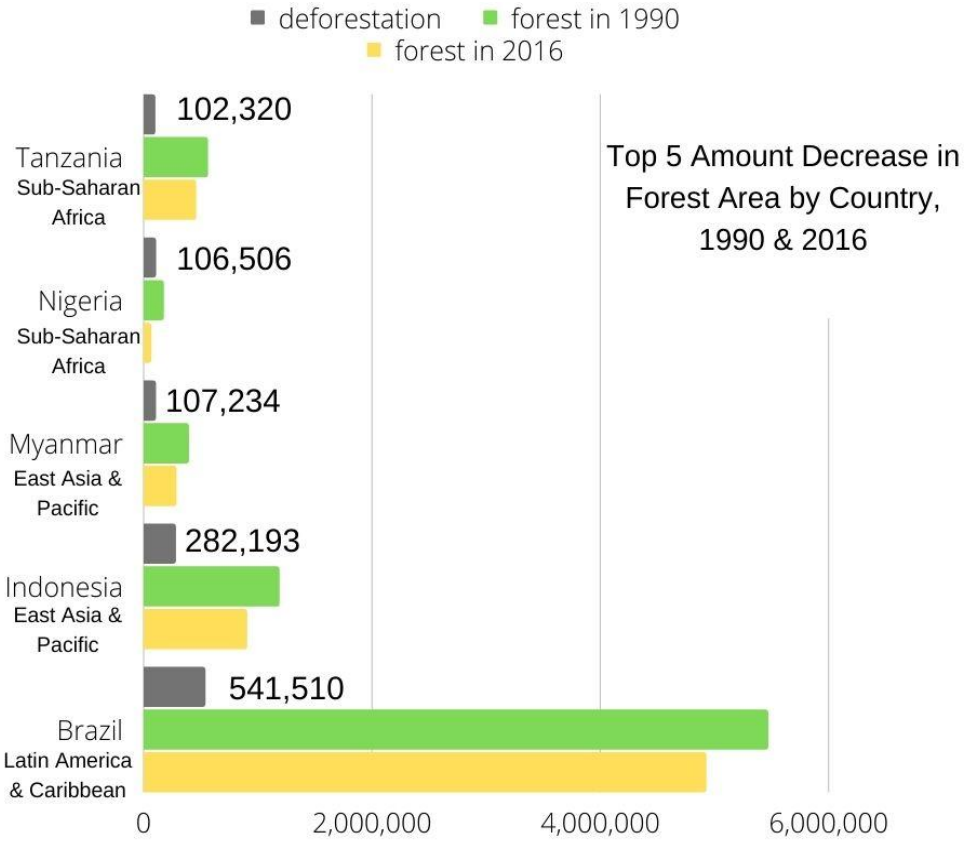
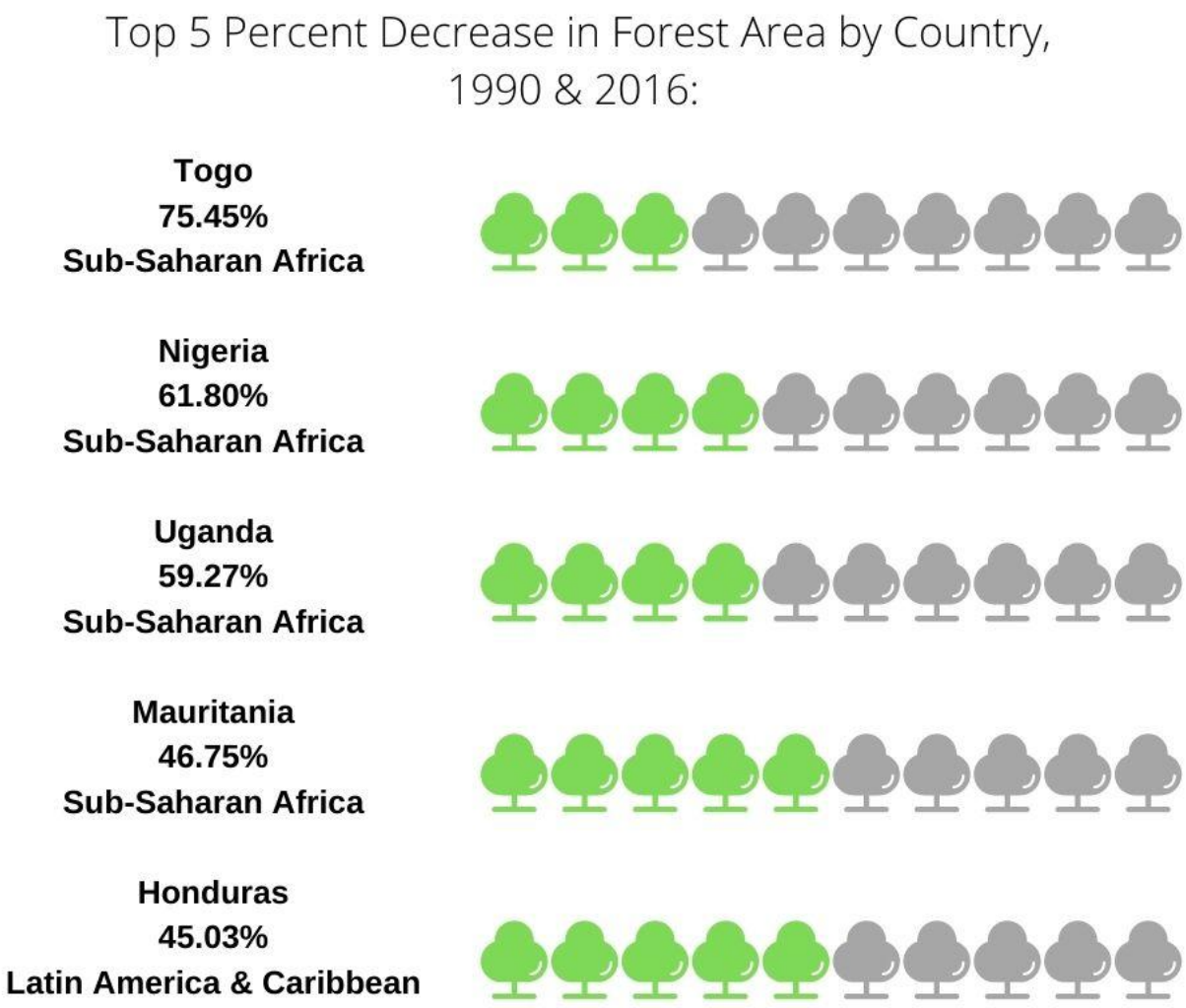


Table 3.1

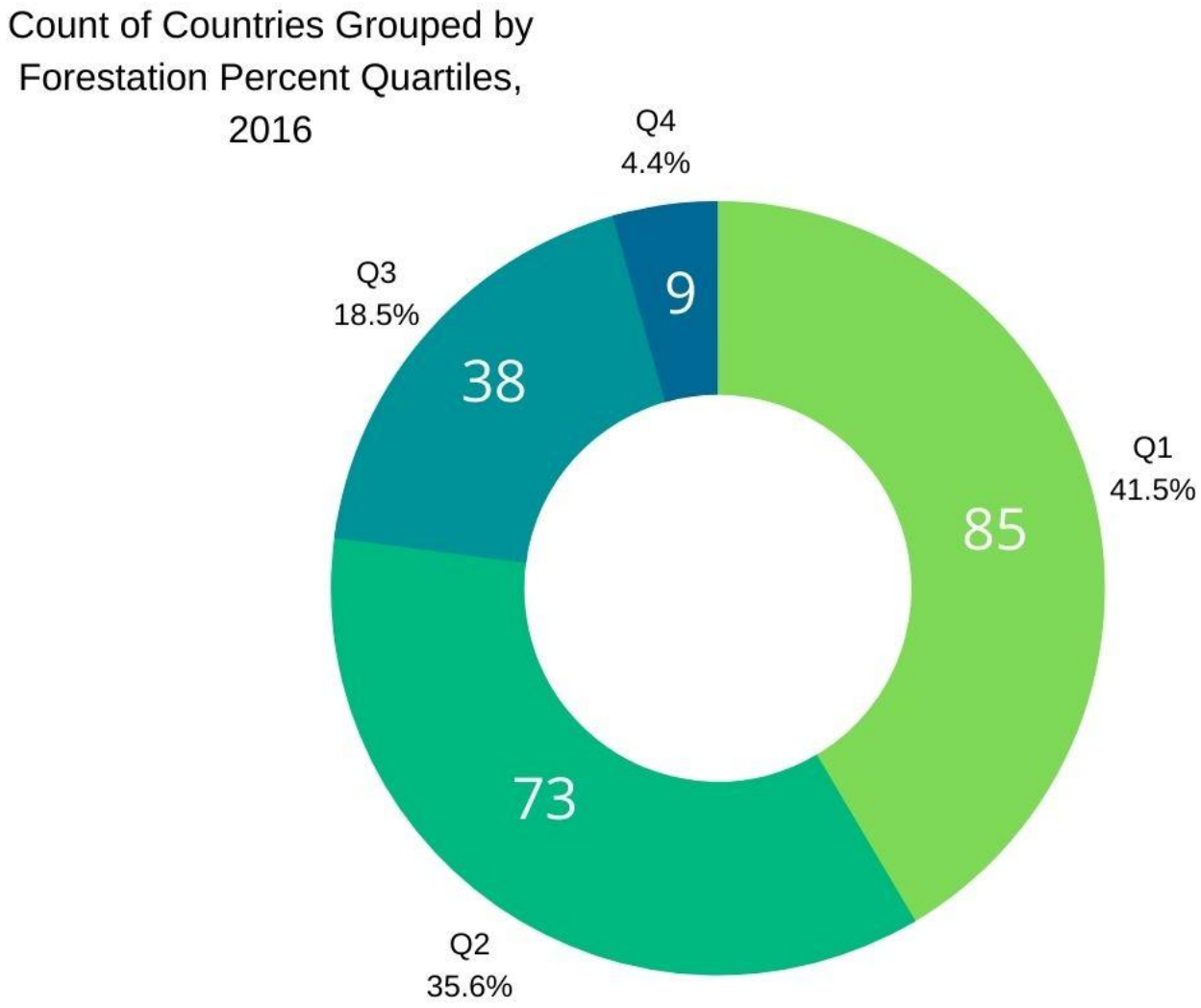
The second way to consider which countries are of concern is to analyze the data by percent decrease. Table 3.2



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.

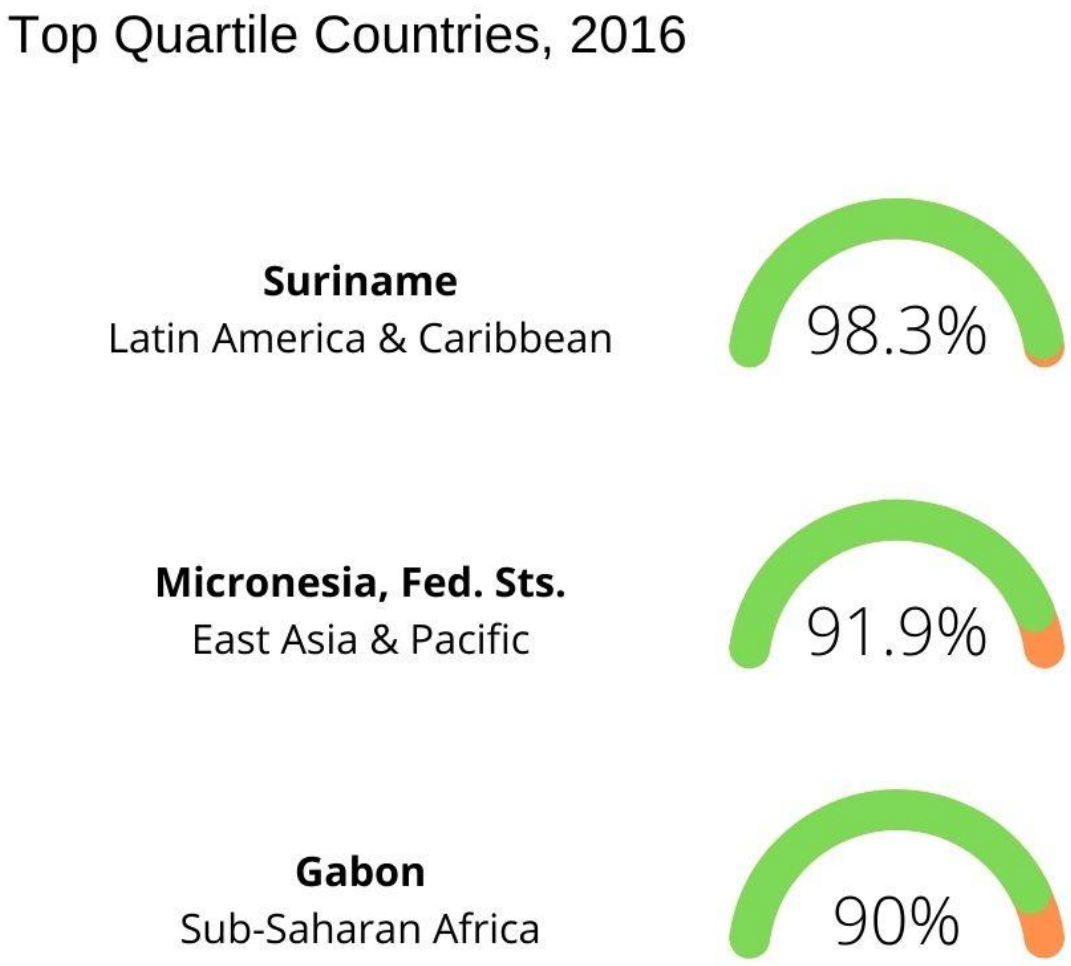
C.QUARTILES



The largest number of countries in 2016 were found in the **1** 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:



C. There are 94 countries that have a higher forest percentage than the US

4. The Good, The Bad & the Green

Deforestation has become a significant major problem in the last years, which should be addressed and gladly there are some countries that have the Answer! .

Observing Deforestation data between 1990 & 2016 it seems, and naturally so, that countries and regions with a Higher income suffer the least if at all from deforestation suggesting there is a clear link between the two, thus said, there are some high income countries like Argentina which is neglecting this issue adding to the wound of that region "Latin America & Caribbean" which is suffering a massive decrease in forest area and is the global leader in deforestation .

The second region to top the charts is Sub-Saharan Africa and not surprisingly with low income countries as a basic.
This region should be in "intensive care", although it's the second region in total deforestation by area, yet here another important factor enters, countries in this region have a lower forest / land percentage than some other regions and yet it's decreasing rapidly ! bringing the forests in this region to an almost extinction status, compared to Latin America & Caribbean which has a high forest percentage and can still have a huge chance to 'breathe' Sub-Saharan Africa and it's countries like Nigeria - the worst example here - or Togo - highest loss percentage worldwide- don't have this advantage
Also knowing that 76% of the world's countries ,including the above Sub-Saharan Africa, have less than 50% forest area, this just adds to the urgency.

As this is a global issue, and affects every corner one way or another, countries should face this issue together and especially the biggest world countries, they somehow top the charts in Reforestation! Massive countries like the US, India, Russia and the crown jewel of all China ! which could have the 'secret formula' to properly resolve or balance deforestation.

As a general guideline, forest area is the the key over forest percentage in reforestation, as where in some countries 1% of forest area can be a size of a whole country, making this bios almost neglectable and we would rather focus on forest area, going back to China's "secret formula" which managed between 1990 and 2016 to Reforest area in the land size of Nations!

APPENDIX: SQL queries used

#removing null rows from tables

```
DELETE FROM forest_area WHERE forest_area_sqkm IS NULL
DELETE FROM land_area WHERE total_area_sq_mi IS NULL

''' ---------------------------------------- '''
```

#creating new table - Forestation View - with non doubled columns

```
CREATE VIEW forestation
AS
SELECT
    t1.country_code AS country_code,
    t1.country_name AS country_name,
    t1.forest_area_sqkm as forest_sqkm,
    t2.year AS year,
    t2.total_area_sq_mi as total_sqmi,
    t3.region,
    t3.income_group,
    t1.forest_area_sqkm  / (t2.total_area_sq_mi* 2.59)  * 100  as
forest_per
FROM forest_area AS t1
JOIN land_area AS t2
ON t1.country_code = t2.country_code AND t1.year = t2.year
JOIN regions AS t3
ON t2.country_code = t3.country_code;

''' ---------------------------------------- '''

'''     Report for ForestQuery into Global Deforestation, 1990 to 2016
'''

'''  1. GLOBAL SITUATION  '''

#1.1 checking world area in 1990

SELECT sum(forest_sqkm)
FROM forestation
WHERE year = 1990 AND country_name = 'World'
''' ---------------------------------------- '''
```

#1.2 checking world area in 2016

```
SELECT forest_sqkm, country_name
FROM forestation
WHERE year = 2016 AND country_name = 'World'

''' ---------------------------------------- '''
```

#1.3 forest size difference between years 1990 - 2016 in sq km

```
SELECT f90.forest_sqkm - f16.forest_sqkm AS difference
FROM (SELECT * FROM forestation WHERE year = 1990) AS f90
JOIN (SELECT * FROM forestation WHERE year = 2016) AS f16
USING (country_code)
WHERE f90.country_name = 'World'
OR f16.country_name = 'World'

''' ---------------------------------------- '''
```

#1.4 forest percentile difference loss between 1990 - 2016

```
SELECT ((f90.forest_sqkm - f16.forest_sqkm) / f90.forest_sqkm)*100
 difference_per
FROM (SELECT * FROM forestation WHERE year = 1990) AS f90
JOIN (SELECT * FROM forestation WHERE year = 2016) AS f16
USING (country_code)
WHERE f90.country_name = 'World'
OR f16.country_name = 'World'


''' ---------------------------------------- '''
```

#1.5/6 checking country with similar land size as the total forest loss difference from 1.4

```
SELECT country_name , (total_sqmi * 2.59) total_sqkm
FROM forestation
WHERE year = 2016 AND (total_sqmi * 2.59) < 1324449 #<--- this number
ORDER BY  2 DESC                                      or code from 1.4

''' ----------------END PART 1 ------------------------ '''
```

''' **2. REGIONAL OUTLOOK** '''

#2.a + 2.b , full forest percentile table overview from 1990 -2016 by region, rounding numbers to 2 decimal

#2.a 2016

```
SELECT forest16.region,
forest16.fp16 AS forest_per_16
FROM (
      SELECT region,
ROUND(((SUM(forest_sqkm)/(SUM(total_sqmi)*2.59)*100) :: NUMERIC), 2)
AS fp16
      FROM forestation
      WHERE year = 2016
      GROUP BY region
                  ) AS forest16
ORDER BY forest_per_16  DESC
```

''' ---------- '''

#2.b 1990

```
SELECT forest90.region,
forest90.fp90 AS forest_per_90
FROM (
      SELECT region,
ROUND(((SUM(forest_sqkm)/(SUM(total_sqmi)*2.59)*100) :: NUMERIC), 2)
AS fp90
      FROM forestation
      WHERE year = 1990
      GROUP BY region
                  ) AS forest90
ORDER BY forest_per_90  DESC
```

''' ---------- '''

#2.c

```
SELECT forest90.region,
forest90.fp90 AS forest_per_90,
forest16.fp16 AS forest_per_16
FROM (
      SELECT region,
ROUND(((SUM(forest_sqkm)/(SUM(total_sqmi)*2.59)*100) :: NUMERIC), 2)
AS fp90
      FROM forestation
      WHERE year = 1990
      GROUP BY region
                        ) AS forest90
JOIN (
      SELECT region,
ROUND(((SUM(forest_sqkm)/(SUM(total_sqmi)*2.59)*100) :: NUMERIC), 2)
AS fp16
      FROM forestation
      WHERE year = 2016
      GROUP BY region
                        ) AS forest16
USING (region)
WHERE forest90.fp90 > forest16.fp16
ORDER BY forest_per_90 DESC
```

'''----------**END PART 2**----------'''

''' 3. COUNTRY-LEVEL DETAIL '''

#3.a checking top Reforestation countries by Forest Area in sq km between 1990 - 2016

```
SELECT f90.country_name,(f16.forest_sqkm - f90.forest_sqkm) AS
difference, f90.region , f90.total_sqmi
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code)
ORDER BY  difference DESC
limit 6
```

''' -- '''

#3.a checking top Reforestation countries by Forest to land percentage between 1990 - 2016

```
SELECT f90.country_name,ROUND(((((f16.forest_sqkm - f90.forest_sqkm)
/ f90.forest_sqkm )*100):: numeric), 2)  AS difference, f90.region
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code)
ORDER BY difference DESC
LIMIT
```

''' -- '''

#3.b.1 Top 5 Amount Decrease in Forest Area by Country, region in 1990 & 2016:

```
SELECT f90.country_name,(f90.forest_sqkm - f16.forest_sqkm) AS
difference, f90.region
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code)
ORDER BY difference DESC
LIMIT 6

#limit to 6 cause the world is included.

''' ---------------------------------------- '''
```

#3.b.2 Top 5 Percent Decrease in Forest Area by Country, 1990 & 2016

```
SELECT f90.country_name,ROUND((((f90.forest_per -f16.forest_per  )/
f90.forest_per)*100):: numeric ,2) AS p_diff, f90.region
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code)
ORDER BY  p_diff DESC
LIMIT 5

''' ---------------------------------------- '''
```

#3.c. counting countries in quartiles depending on the forest percentage in 2016.

```
SELECT  Q16.quartiles, COUNT(Q16.country_name) AS Country_count
FROM (
      SELECT country_name,
        CASE
          WHEN forest_per >= 0 AND forest_per < 25 THEN '1'
          WHEN forest_per >= 25 AND forest_per < 50 THEN '2'
          WHEN forest_per >= 50 AND forest_per< 75 THEN '3'
          ELSE '4'
        END AS quartiles
      FROM forestation
      WHERE year = 2016
                      ) AS Q16
GROUP BY quartiles
ORDER BY Q16.quartiles

''' ---------------------------------------- '''
```

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

```
Select Country_name , ROUND((forest_per) :: NUMERIC,2) , region
from forestation
where year = 2016 and forest_per > 75
order by forest_per desc
''' ---------------------------------------- '''
```

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

```
SELECT COUNT (*) AS countries_more_us
FROM forestation
WHERE year = 2016 AND forest_per > (
                                    SELECT forest_per
                                    FROM forestation
                                    WHERE country_name = 'United
States' AND year = 2016
                                    )
 # = 94 countries have higher percentage than the USA

'''-----------------END PART 3---------------------------------'''
```

'''Tables used for Recommendation'''

#total region diff 1990 -2016

```
select SUM(diffErence)as deforestation ,  REGION_DIFF.region
FROM
(SELECT f90.country_name,(f90.forest_sqkm - f16.forest_sqkm) AS
difference, f90.region, f90.income_group
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code) ) AS REGION_DIFF
group by 2
order by 1 DESC
```

''' -- '''

#income of the top/low Reforestation countries by forest area

```
SELECT f90.country_name,(f16.forest_sqkm - f90.forest_sqkm) AS
difference, f90.region , f90.total_sqmi, f90.income_group
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code)
ORDER BY  difference DESC
limit 10
```

''' -- '''

#total region diff 1990 -2016

```
select SUM(diffErence) ,  REGION_DIFF.income_group
FROM
(SELECT f90.country_name,(f90.forest_sqkm - f16.forest_sqkm) AS
difference, f90.region, f90.income_group
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code) ) AS REGION_DIFF
group by 2
order by 1 DESC

''' ---------------------------------------- '''
```

#countries count in each income group 1990 and again in 2016

```
select count(income_group) y90 , income_group
from forestation
where year = 1990
group by 2
order by income_group
```

 # checking any changes in each county income group between 1990 = 2016

```
SELECT f90.country_name as c1990,
       f16.country_name as c2016,
       f90.income_group as y1990,
       f16.income_group as y2016,
       f10.income_group as y2010,
       f90.region
FROM (
      SELECT *
      FROM forestation
      WHERE year = 1990
                        ) AS f90
full JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2016
                        ) AS f16
USING (country_code)
full JOIN (
      SELECT *
      FROM forestation
      WHERE year = 2010
                        ) AS f10
USING (country_code)

order by f90.country_name
```